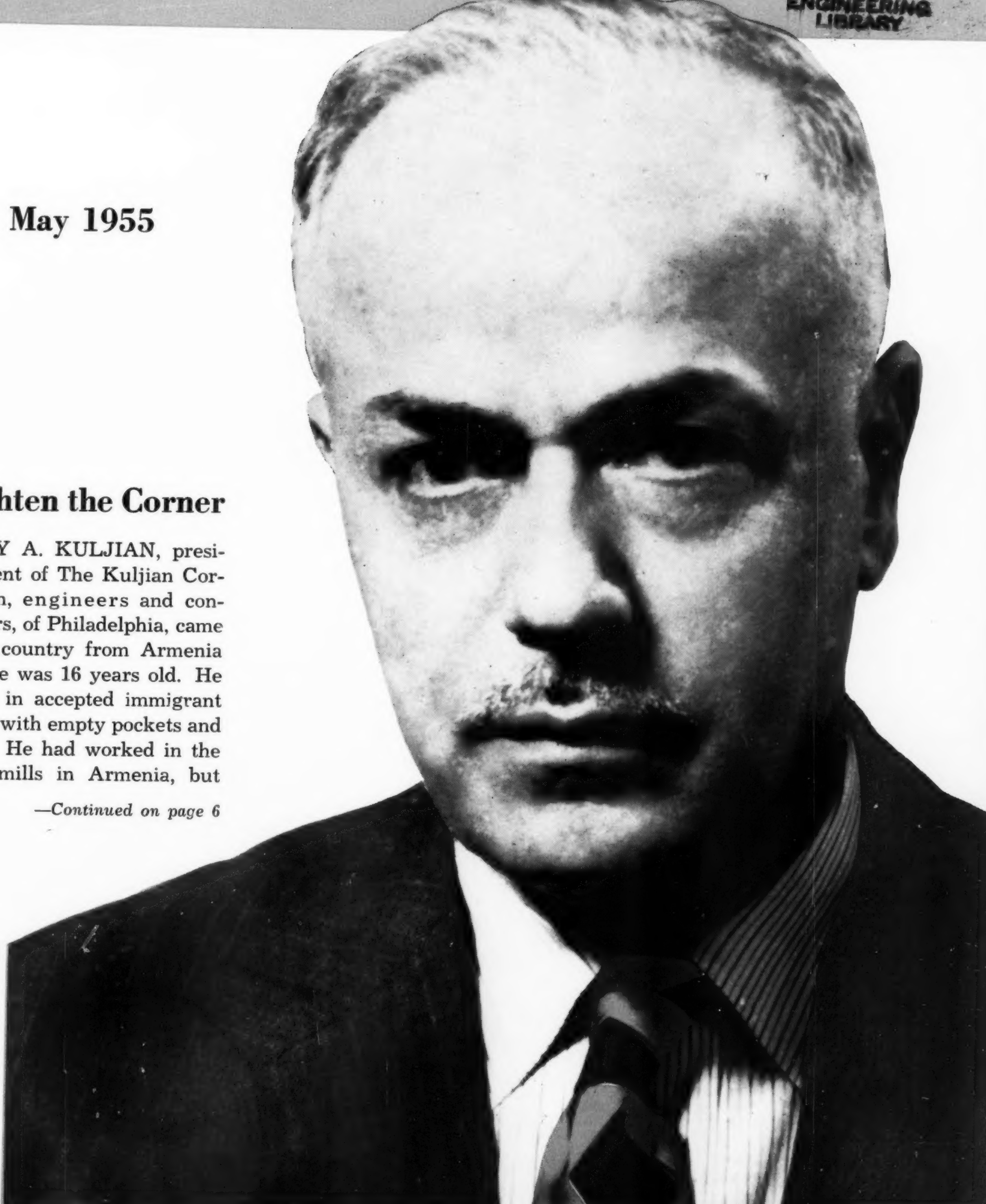
consulting engineer

May 1955



Brighten the Corner

HARRY A. KULJIAN, president of The Kuljian Corporation, engineers and constructors, of Philadelphia, came to this country from Armenia when he was 16 years old. He arrived in accepted immigrant fashion with empty pockets and no job. He had worked in the textile mills in Armenia, but

—Continued on page 6

The Consulting Engineer's Professional Magazine

NEW DIMENSIONS IN CENTRALIZED CONTROL

Two story benchboard controls giant multiple fuel cyclone fired boiler!

The 125,000 KW extension to Raritan River Plant of Jersey Central Power and Light Company can be operated entirely from the compact benchboard shown here. This console, built by Hays and designed by Burns and Roe, Inc., consolidates the necessary control stations and miniature indicators in a small space yet provides easy accessibility for servicing.

In addition, this new design two story benchboard reduces costs three ways:

Lower operating costs—fewer men operate more equipment.

Lower installation costs—entire board fabricated by Hays. Minimum field piping and wiring.

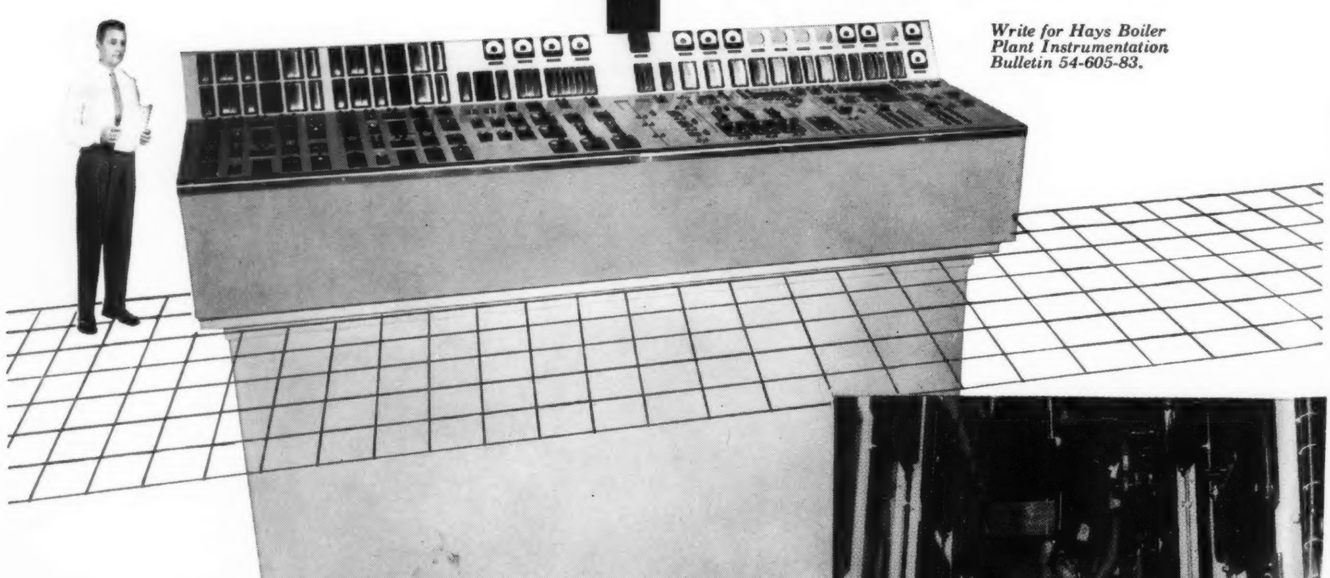
Lower maintenance costs—easy accessibility for maintenance from *inside* the panel (photo below).

Four cyclone furnaces are employed by the pressurized steam generator to deliver 900,000 lbs/hr. of main steam at 2,000 psig, 1050° F. and 740,000 lbs/hr. of reheat steam at 430 psig, 1000° F. The boiler is designed to burn coal and gas in any combination in all cyclones.

A Hays electrically operated combustion control system was selected by Jersey Central. Its electric operation eliminates the need for expensive compressors and dryers and allows maximum flexibility in central control location. Provision has been made in the system for future addition of oil as a third fuel with no loss in flexibility.

Hays paramagnetic type O_2 analyzers with new design sampling systems and electronic recorders are used for oxygen compensation of the control system.

Write for Hays Boiler Plant Instrumentation Bulletin 54-605-83.



Inside view of pan

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Brighten The Corner

—Starts on front cover

again in the immigrant tradition, he had no desire to continue in this new country a trade learned in the old. America had to be different—and for Kuljian it was.

For the next eight years, Kuljian concentrated on getting an education. He went to high school during the day and worked behind a counter in a restaurant at night. He found that he learned quickly and that he had a real aptitude for mathematics. When he got his diploma from high school, his teachers encouraged him to go on to some technical college. Following his same schedule of school by day and work by night, he went through MIT, getting his engineering degree in 1919. He was, he admits, constantly astounded at the fact that he, an Armenian textile worker, had been able to both support himself and get a fine education in just a few years in a new country. He still seems rather bemused by this thought.

He developed during those early years in this country a profound patriotism that he has never lost. This is a type of patriotism that even the most dedicated native American can seldom display without descending to chauvinism. Not so with Kuljian. His love of this country is so obviously sincere, so simple and direct that it is beyond the emotional level of most native born. "What a wonderful place is this America," Kuljian says.

"I think it was one day when I was still in MIT that I decided I wanted to be a builder. I was riding a streetcar in Boston. The famous preacher, Billy Sunday, was in town, and all the people had been to hear him preach. He had a song everyone liked. It was 'Brighten the Corner Where You Are,' and all the people on the streetcar were singing that song. I thought the best way I could 'Brighten the Corner' was to become a builder. I knew about some dark corners in the old world. It would take a lot of building to brighten those. They are very dark.

"It was not always easy for me to learn at MIT. Sometimes, before I got my degrees, I thought I had worked enough. Then one day I read in a text book a definition of work. This book said, 'Work is done when a body is moved against a resistance over a distance.' Those two words in that definition impressed me, 'resistance' and 'distance'. I knew what they meant. Perhaps they meant more to me than to most people who were not familiar with quite so much 'resistance' and 'distances' so great. I then understood work, not only in a mechanical sense but in a philosophical sense. I kept right on working.

"Work is one important factor in the equation for human accomplishment. Another is time. When I went to work for Stone & Webster, I set a time limit. I decided on ten years, five years with them and five years with another company. Then I should know enough to have my own engineering firm. But just setting a distant time limit is not enough. Time goes by minutes and days as well as by years. I have always taken a few minutes each morning, usually at breakfast, to jot down notes to remind me what to do that day. They are little instructions, but altogether they add up to the big instructions, the ones that say, 'In ten years I will do so and so.'

"After those ten years, it was 1930, and not the best time to start a new engineering firm. However, I decided to make a start. When it is low tide, it is a good time to learn to swim. Later, James L. Cherry joined me in this new business, and together, we made a go of it. During those days, I kept saying to myself, half jokingly, 'maybe we can be another Stone & Webster.' In 1943 we had 1250 men on the Kuljian payroll. That gave me a fine feeling. Our client list began to include such names as American Viscose Corporation, Sun Oil Company, Esso Standard Oil Company, Ford Motor Company, Army Corps of Engineers, U.S. Air Force, James Lees & Sons, and many others that helped us grow.

"It is natural that I should be interested in foreign projects. I still remember those people singing 'Brighten the Corner' on that streetcar in Boston.

"During the war and since, we have done a lot of work in what are called the industrially-underdeveloped countries. We built a large power plant in India. We have also done a great deal of work in the Far East, the Middle East, and in South America. And, too, we have done work in Europe — just after the war and before they were able to help themselves. I do not mean that we gave this engineering work away. We made good profits, good fair profits, but it is especially satisfying to see electric generating plants go up where the light is most needed . . . where it can brighten the darkest corners.

"Here, now, is the great problem. In 1952 about 35 percent of our work went to foreign projects. But for the last two years this has been more than cut in half. Only about 15 percent of our work is now performed in foreign countries.

"This trend is not just for The Kuljian Corporation, it holds true for the other U.S. engineering firms as well. We are all losing in the foreign market, and it is not right. There is no good reason for being cut out of this business. On the other hand there is every good reason we should have it.

"Here is the way this has happened. After the war there was the Marshall Plan. We gave many goods and services to the countries of Europe that needed them so much. We also aided the nations that were industrially retarded. During that period, the years just after the war, we U.S. engineers really had no competition for these projects in Asia and South America. Europe was short of engineers

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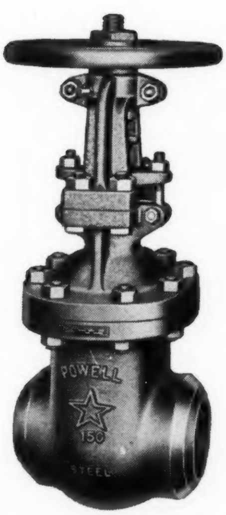


FIG. 1503WE—150-Pound Steel Gate Valve.

FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

FIG. 19003—900-Pound Steel Pressure Seal Gate Valve.

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

POWELL VALVES

and equipment. They had more than they could do to rebuild their own countries, even with our help.

"In the past two years the situation has radically changed. Instead of competing with the engineers and manufacturers of a rebuilt Europe on an equal basis, (which we certainly would not mind doing) we now find we cannot compete with them at all.

"Why? What is the big change?

"Europe is now rehabilitated, partly with U.S. dollars. They are making more heavy industrial equipment than they ever did before. They must find markets for this equipment, and the natural place to look for the markets is in the industrially-underdeveloped countries. These nations have the money to buy because we have given the money to them under our foreign aid program. The only question is where they are going to spend it. When we give this economic aid, there is no stipulation as to where they must buy. They can buy their equipment and their engineering work from the United States or from Europe. Naturally, they spend it where they seem to get the most for their money, and that place today is generally Europe.

"The Europeans are in a unique position. They can underbid us and still make money — our money. For example, U.S. engineering firms and manufacturing firms are separate corporations, and operate separately in foreign countries just as they do here in the United States. We are asked to give our price for engineering work on some project, and we quote a price based on 3 to 5 percent of the cost of the job in accordance with recognized fee schedules. The equipment manufacturers bid separately on the machinery. There is no tie-in between us.

"Not so the European engineer. He is a sort of manufacturer's agent, specifying a particular manufacturer's products. Obviously, he can cut his engineering fee to almost any figure he desires — 1 percent or even less. This means the American engineer does not have a chance of getting the job.

"Then what happens? The European manufacturer absorbs the engineering fee in the price of his equipment. There are several reasons he can do this. If the equipment is of a type that represents a lot of labor in its selling price, the lower wage rate keeps the comparative price down. If this advantage is not enough, there are both direct and indirect subsidies from his government, designed to aid foreign trade. There are tax advantages or other forms of assistance to those manufacturers who export their goods — especially those who will export to nations with dollars given them by the United States. Naturally, Europe wants dollars.

"Now comes the joker. How can the European governments afford to give these subsidies to their manufacturers, permitting them to underbid our manufacturers? It is quite simple. They use our foreign aid money! So what this really amounts to is a situation in which we give money to an industrially-underdeveloped nation to buy equipment, then we give money to revitalized nations so they can underbid us on the equipment to be bought.

"Do not think I am against foreign aid. I, perhaps more than other American engineers, should know how much it is needed in those dark corners, but I also know we are going about this in a very unfair way. It is possible to brighten those corners without ruining our own foreign markets.

"Every engineer knows that in a major project such as a power plant, about half of the cost goes into mechanical and electrical equipment. The other half goes into building materials and labor, which, for the most part, are available in the area where the project is to be built. Our government should give only this 50 percent in cash. The other half should be made available as credit against U.S. equipment, this equipment being purchased on the basis of competitive bidding or under engineers' specifications.

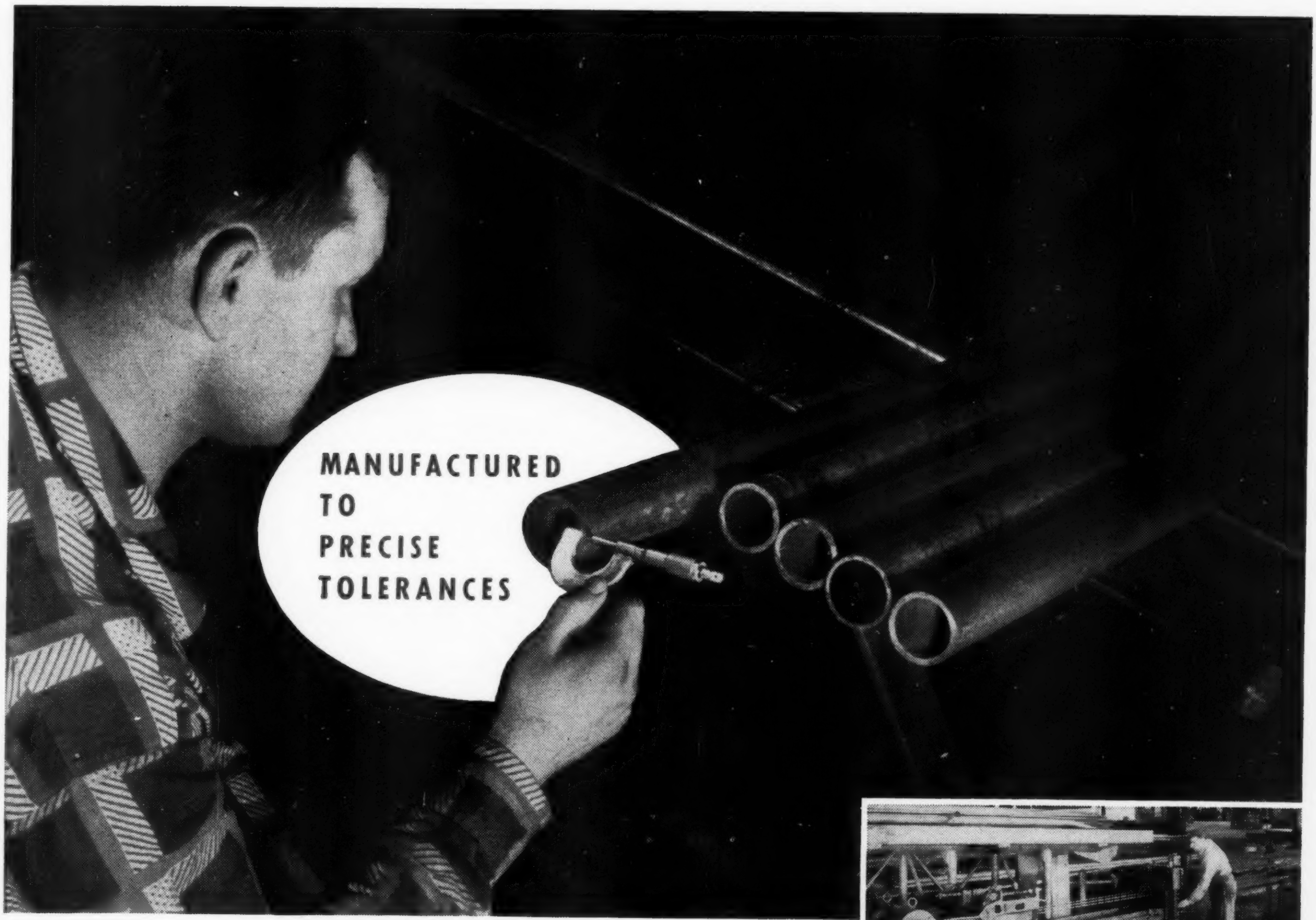
"This would assure U.S. equipment manufacturers and U.S. labor a break when their own money is being used to buy equipment.

"The American engineer would then have a competitive chance on a foreign job, for the European engineer, without his agent's fee from the manufacturer, would have to charge in accordance with actual costs or desired profit. We could then compete with them on an equal basis, each of us paying our own way and making profits from our engineering work unaided by sales agent's fees.

"We need not worry that a stipulation requiring aid money to be used to buy American rather than European equipment would destroy all of Europe's recent economic gains. They are, through their subsidy and tax aids to manufacturers, more than competing with us currently on the world market. Surely, it is not much to ask for a chance to get the business in areas where our own foreign aid money is being used. Germany, France, England, and the other countries of Western Europe still have many parts of the world other than these industrially-underdeveloped countries to which they can sell their goods. In fact, most European countries have heavy trade advantages outside our 'foreign aid area' because of Commonwealth or colonial ties. No one could call us greedy or 'dollar diplomats' for asking merely that half the money we give as aid be spent to buy the needed equipment from us.

"We make good equipment at a fair price. In fact, we could compete in spite of our higher labor costs if competition were fair. It is only when our own money goes to foreign manufacturers to permit them to cut their sale price that we no longer can compete. We stand and blithely cut our own throat with our own knife.

"It is time this unwise and unfair procedure was ended. We should brighten the corners of the world, but if we pay for it, the light should come from American manufacturers' generators."



For heat exchangers and condensers...

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The ability of cold drawn wrought iron tubing to reduce the frequency of repair or replacement in these and similar services is amply supported by actual service records.

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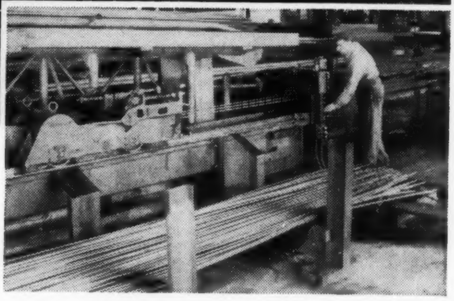
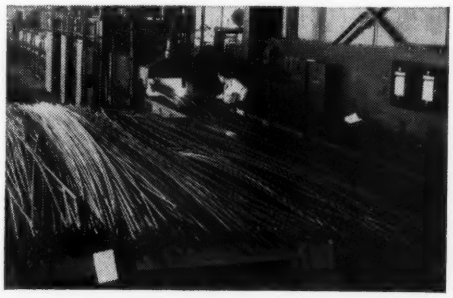


"Drawing" process—mandrel controls inside diameter and die reduces outside diameter as tubing is drawn. Interior and exterior of tubing are smoothed in process.



Annealing process restores ductility of the tubing. Ring gauge is then used to check OD, followed by a micrometer reading for wall thickness.

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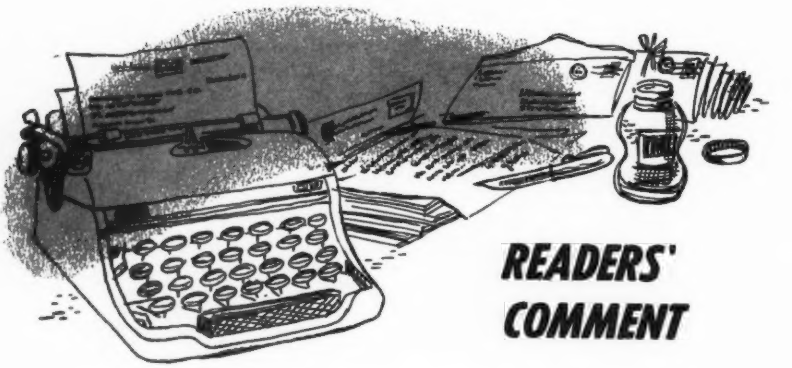


READERS' COMMENT

Telephone Listings

The more I read your magazine the better I like it!

The typography and general makeup of the publication are praiseworthy. I greatly enjoy the articles on "The Legal Aspect" by Melvin Nord, and I find your editorials very much worth reading.

Your "Scraps and Shavings" in the April issue is pertinent and wonderful, but aside from eliciting a heartfelt "amen" from fellows like me, I wonder if it will get more than a raised eyebrow or two from the "engineering" societies. They are mainly interested in big attendance records rather than in any real activity to promote engineering as a profession.

I believe that the medical and legal professions can in many ways serve as guides in crystallizing a valid professional status for consulting engineers. Your article discusses one facet that the medical and legal professions have settled. Another very important item that I find little discussed is the subject of "free" engineering directly for clients by manufacturers' sales engineers and by utility companies. This is analogous to a pharmaceutical house prescribing dosages directly for patients and thus by-passing the physician.

If consulting engineers ever achieve a real professional organization like the AMA or the bar associations, I believe the problem of "free" engineering will have to be resolved.

Maurice B. Cook
Consulting Engineer
Lincolnwood, Ill.

The article ("Scraps and Shavings") in the April issue of CONSULTING ENGINEER, dealing with classified telephone listings, is indeed interesting in view of the concentrated study that has been given this topic by the National Society of Professional Engineers' Ethical Practices Committee. For some time, this committee studied the various methods of listing engineers in telephone directories and . . . presented the following recommendation to the Board of Directors for action:

"ENGINEERS — REGISTERED PROFESSIONAL
"CIVIL
John Doe. . .400 Dexter Avenue. . . Anyplace 9600
"ELECTRICAL
John Smith. . .100 Main Street. . . Anyplace 5500
"MECHANICAL
Harry Jones. . .111 Park Street. . . Anyplace 9100"

The foregoing . . . was adopted by the Board of Directors in Feb. 1954, and since that time each State Society has been requested to contact the telephone companies directly and, through their respective chapters, to bring about acceptance and use of the uniform listing. Considerable progress has been made in this direction, and we are still bending every effort to have the uniform listing adopted by all phone companies.

Incidentally, on page 86 of the April issue, It is noted that the NSPE Annual Meeting was not included in the Calendar. . . .The date: June 2-4; the place: Bellevue-Stratford Hotel, Philadelphia.

Paul H. Robbins
Executive Director
National Society of Professional Engineers.

Professional Atmosphere

I am active in the LaFayette Chapter of the Indiana Society of Professional Engineers and from time to time have the opportunity to counsel young men just entering the engineering profession.

Your personality piece on Duane

—Continued on page 14

Continued from page 10

Couzens Hormell in the February issue can be a motivating piece for a young man. It spells out clearly the professional atmosphere under which a young man would like to start his career. This is in sharp contrast to the surroundings in a company having a collective bargaining unit for its engineers.

Frederick B. Morse
Consulting Engineer
West LaFayette, Ind.

In The Smaller Office

I would like to congratulate Professor John F. Lee for his article "How Long Should He Be On The Board" appearing in your February issue. I agree with many of his statements, but feel that his comments are directed at conditions in the larger Engineering Firms and Industry, where practices of specialization seem to be gaining ground.

It seems that Professor Lee has completely overlooked the smaller engineering office where limited personnel does not permit stratification into "thinkers" and "doers." In the small office, a broad engineering background including drawing proficiency is a necessity. So let's not encourage all our future engineers to neglect the traditional prerequisites for engineering success, for there is still a great opportunity for the "General Practitioner" in the engineering profession.

William G. Dryden
Kenneth Larkin & Associates
Kansas City, Missouri

Praise

I appreciate and enjoy receiving your magazine and feel that you are assisting us engineers in no small way toward our goal of recognition which we think we rightfully earn.

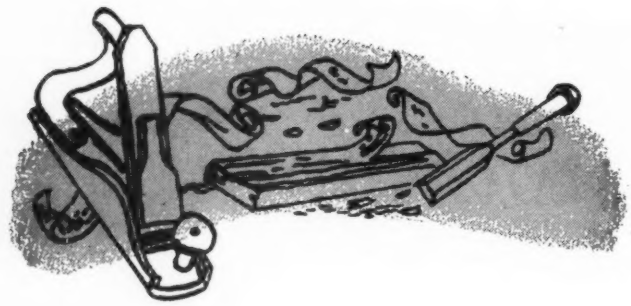
LeRoy H. Nettnin
Nelson & Nettnin, Inc.
Chicago, Illinois

We digest and circulate our copy to very good advantage and find your material solid and informative.

A. V. Thompson, Librarian
Buonaccorsi, Murray & Lewis
San Francisco, Calif.

I greatly appreciate receiving CONSULTING ENGINEER and after reading my copies file them for reference and refer frequently to the filed volumes.

John F. Heath
Consulting Engineer
Salt Lake City, Utah



SCRAPS & SHAVINGS

THIS SPRING the voice of the turtle is being drowned by the caterwauls of the culture hawks. Complementing the article, "The Trouble with Engineers," in the January issue of *Harpers*, is a second article, this one in *The Saturday Evening Post*, entitled, "How to Humanize a Scientist."

The article is based upon the assumption that engineers "inhabit a grim 'practical' world, wise in technology, ignorant of human problems." The *Post* solution is to pass the engineering students "a helping of poetry and philosophy . . ." This prime assumption we believe false. We are unwilling to concede that engineers, ten years out of school, are any more ignorant of politics, art, music, philosophy, literature, and the social sciences than any other comparable group. It would be interesting to see the results of a "cultural" test taken by engineers, lawyers, doctors, accountants, dentists, personnel directors, and free-lance writers. Until the results of such a test are published, we will not agree to a label of "skilled barbarian" placed upon the engineering profession by either a personnel director writing in *Harpers* or a free lance writer in the *Saturday Evening Post.*

Milton MacKaye, is the *Post* author who sees hope for the engineer in combining Shelley with the slide rule and Thoreau with thermodynamics.

MacKaye did his research for the *Post* article by visiting Rensselaer and MIT. At Rensselaer, MacKaye discovered that it is impossible to present all the knowledge associated with an engineering speciality in four collegiate years. "Or four years more." Therefore, industry is only asking that students "be given a sound education in basic engineering principles with only a reasonable emphasis on their chosen fields." There is something wrong with Mr. MacKaye's argument. If it is impossible to teach an engineering speciality in four years, how much more impossible would it be to teach basic engineering principles in that same length of time. It just cannot be done.

We know, and we think most engineers in practice know, that there was not nearly enough time in the four years in engineering school to give us the education in basic principles we ideally should have received. Is there one of us who would not now admit that he should have had a better background in pure mathematics, a more intensive course in strength of materials, double the time that was given to thermodynamics, and certainly a triple dose of mechanics? That is the problem. There just is not the necessary time in a four year course to teach both Engineering and Foundations of Western Culture. Somehow, according to MacKaye, they are managing this at RPI and MIT. Last year the RPI hockey team won a national collegiate championship. There is an orchestra, band, glee club, debating society, dramatic society, and student newspapers and magazines—altogether 82 extra-curricular activities. RPI also has a social director (who would seem absolutely essential with 82 activities to keep up with). Her purpose is best expressed by Mr. MacKaye, himself:

"If a buck engineer graduates without a going knowledge of what to do with that pesty fingerbowl or the third fork on the right, he has only himself to blame. Mrs. W. is there to be consulted."

Just what Mrs. W. would tell him to do with the third fork on the *right* is an interesting question. We would try, unobtrusively, to shift it and the other two over to the *left* before the hostess noticed it and fired her maid.

Finally, MacKaye gets around to the real problem. How do you find room for new subjects in an already crowded four years. It apparently was simple at RPI. They had an old course in stonecutting. They were also giving two years of surveying to all engineers including electricals and chemicals. They cut these out and substituted liberal arts courses. RPI was lucky. Most technical schools do not have such an obviously outdated curriculum from which to cull.

We need not less, but more emphasis on pure, basic technical education for the engineer. There will not be room for the liberal arts courses until the educators understand that four years is not enough. There is as much to learn in engineering as there is in law or medicine—probably more. We cannot continue to have so little time to learn so much. There should be a full, two year pre-engineering course, half of which would be given to basic mathematics, chemistry, physics, and the pure sciences—and the other half would be given to the liberal arts. Following this there should be four full years of engineering. That is what we need. The sooner we get it the better. ▲▲

the Legal Aspect

MELVIN NORD

Consultant in Legal and Technical Problems

Registered Professional Engineer

Patent Attorney

. . . *Workmen's Compensation*

IN THE LAST FEW COLUMNS in this series, we have been discussing the "master-servant" relationship. We have found that at the common law an employer is not liable for injury to his employees unless he has been negligent, that is to say, unless he has failed to take reasonable care: (1) to provide a safe place to work, (2) to provide safe equipment, (3) to warn employees of dangers of which they might not be aware, (4) to provide suitable fellow-workmen, or (5) to make reasonable rules for conducting the work. Furthermore, we have found that even if the employer is guilty of negligence, he has three defenses which frequently protect him from liability, i.e., contributory negligence, assumption of risk, and the fellow-servant rule. As a result, under the common law, the employee rarely can recover damages from his employer for injuries sustained while he is on the job.

Because of this, statutes have been passed in nearly every state providing employees with compensation in specified amounts for their injuries regardless of the employer's negligence or other fault and regardless of the three defenses mentioned. Such statutes are known as the Workmen's Compensation Acts. These acts are admittedly intended to favor employees and are liberally construed in their favor. They shift the burden from the employee onto the employer, who is expected to add it to his costs and so ultimately transfer it to the consumer. A compulsory insurance scheme helps to spread the burden over the entire industry and to make the payment of claims certain.

The acts are not entirely uniform, and it is necessary to read the statute and case decisions in order to know the law of a particular state. However, there are a great many generalizations that can be made.

Only about a quarter of the statutes are compulsory, about half are compulsory only as to public employment or specific industries, and the rest are "elective". The elective statutes give both the employer and the employee the option of remaining under the common law, but put pressure on the employer by removing the three defenses mentioned above if he refuses to come under the act — and they put pressure on the employee by leaving these defenses in effect if he elects to stand on his common-law rights. Some of the acts are limited to extra-hazardous occupations or to a list of employments classified as hazardous.

In more than half of the statutes, employers having less than a specified number of employees are not included. Farm workers are generally excluded.

Liability under Workmen's Compensation Acts depends on the existence of an employer-employee relationship. The typical workmen's compensation act provides compensation for "personal injuries arising by accident out of and in the course of the employment". In many states, occupational diseases have been held not to be "accidental." Almost half the states have amended their statutes to include all or certain specified occupational diseases. Injuries inflicted intentionally on the employee have been held to be accidental unless the employee has brought it on himself, for example by engaging in a fight or by purposely injuring himself.

The words "out of and in the course of the employment" are also applied in common-law cases in which an employee has injured a third person. However, they are given a more liberal interpretation in Workmen's Compensation Cases.

The liability of an employer under a Workmen's Compensation Act (i.e. the liability of his insurance company), is definitely limited by the compensation statute of the state.

The compensation statute is a complete substitute for the common-law remedy whenever it is available, and the employee has no choice of remedy against his employer. However, if the employee is not entitled to a compensation award (for example, because the injury did not arise out of his employment), he may have a common-law remedy against the employer if he can prove negligence and can

overcome a common-law defense.

If an employee is injured by a third person, he has both a compensation claim against his employer and a common-law right against the third person. He cannot collect twice, however. If he elects the common-law suit first and wins, in some states he loses his compensation rights even if the collection under the judgment is less than the compensation claim. Other states allow him to make up the difference. Most states will allow him his compensation if he loses his common-law suit. If the employee first elects to take compensation and later starts a common-law suit against the third party, the law varies from state to state, and the particular statute must be consulted.

A few recent cases will indicate the extent to which the courts will go in order to protect an employee who is covered by the Workmen's Compensation Act.

In *Fishman v. S.W. Layton, Inc.*, 130 New York Supplement (2d) 656, decided on May 19, 1954, the employer operated a retail optical business and employed the plaintiff as a bookkeeper. The day of the episode was very hot, and the bookkeeper became sleepy. About 3 P.M. she was persuaded by some of her co-employees to drink a mixture of Coca Cola and the contents of a benzadrine inhaler, in order to continue work. As a result, she suffered a cerebral hemorrhage with coma and paralysis of the left side. Medical testimony indicated that these conditions resulted because of weak blood vessels damaged by a previous disease. The Workmen's Compensaton Board awarded her Compensation, and the defendant's insurance company appealed on the ground that the accident did not arise "out of her employment." The court held that she was entitled to the award. Obviously the result under the common law would have been no recovery, since the employer was not negligent. Yet, it seems that most people (except insurance companies) would agree that the de-

cision was proper under the Workmen's Compensation Act.

In *Du Charme v. Columbia Engineering Co., Inc.*, 31 N.J. Super. 167; 106 Atl. (2d) 23, decided June 17, 1954, Du Charme worked in the company's tool crib department. At 12:32 P.M. on Dec. 21, 1951, he finished his duties, washed up, and punched out. However, he did not leave his employer's premises, but went downstairs to the first floor where a Christmas party had been arranged for management and union representatives. He did not take part in the party, but remained there for a while because the general manager had requested him to await the arrival of some hams which were to be given to the employees as Christmas gifts. Upon receiving his gift, the employee proceeded to leave the plant, and in so doing slipped on an out ide stairway leading from the plant entrance to the public sidewalk. He sustained injuries. The court affirmed an award of the Compensation Board, stating that the employee's injuries arose out of and in the course of his employment because the party and the gifts were not merely for the benefit of the employees but for the purpose of furthering good labor-management relationships. It is very doubtful whether the court would have held the same under the common law, but most people (not including insurance companies) would probably agree that the decision was proper under the Workmen's Compensation Act and, in addition, was in the Christmas spirit.

In *Jamison v. New York State Temporary Commission on Agriculture*, 130 N.Y. Supp. 148, decided April 24, 1954, the plaintiff was employed as a secretary. She customarily took an hour and a half for lunch, but on April 11, 1951, because of extra and pressing work, she did not leave for lunch until 1 P.M. and was instructed by her employer to come right back. About 45 minutes after she left for a hasty lunch, she was hurrying back to her place of employment and was injured in a fall. The Compensation Board and the court agreed that she was entitled to an award because the injury arose out of and in the course of her employment. As usual, the insurance company failed to agree, but the court made up for this deficiency of spirit.

It should not be supposed, however, that the insurance company never wins. In *Rybitski v. Lebowitz*, 175 Pa. Super. 265; 104 Atl. (2d) 161, the employee was fatally injured by a railroad train off the employer's premises. On Nov. 14, 1951, he had gone out to buy some coffee and biscuits for himself and other employees for their usual coffee break, but he was fatally injured on his way back when he took a short cut over the railroad tracks. In this case, the Compensation Board and the court agreed that no compensation could be given his widow under the Workmen's Compensation Act, the explanation being that this errand was purely for the personal convenience of the employees and had no relation to the employment. Perhaps the result would have been the reverse in some other state — or at a different season of the year.

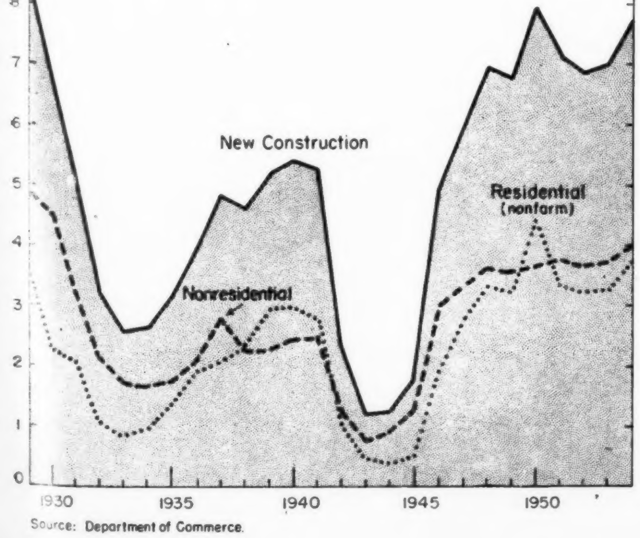
ECONOMIC NEWS NOTES

E. F. Mac Donald
INDUSTRIAL ECONOMIST

OPERATION DECENTRALIZATION — Another method of getting manufacturing companies to locate new defense plants outside cities that would be likely target areas is reported to have been recommended to the President. A special task force studying the problem has suggested that unless firms put new construction outside target areas, they be refused the right to depreciate the property at an accelerated rate. There are reported opinions that residential building should be curtailed in target areas. The trick would be turned by withholding government guarantee or insurance on mortgages to builders in target zones.

BOOM AND BUST? — Pronounced peaks and valleys feature the curves plotted on the accompanying graph. Shown as a percent of gross national product, construction outlays appear headed for an all-time high. In the midst of a surprising display of strength in construction contract awards, however, there are appearing notes of caution and warning, particularly with respect to residential building. The Life Insurance Association of America, for example, warns that 30-year mortgages with no down-payments are "an invitation to boom and bust." And the U.S. Savings and Loan League feels that there should be a "re-examination of Government policies to prevent possible overbuilding."

CONSTRUCTION AS A PERCENT OF GROSS NATIONAL PRODUCT



Source: Department of Commerce.

HATS OFF — They flew specially designed safety flags recently at various sites of du Pont construction to salute the completion by their Construction Division of 12 months of heavy building at 34 locations in 15 states without a single lost-time injury to a worker. All told, 9,000 building workers accumulated 7 million accident-free hours. At the expected accident rate this work would have produced over 200 accidents.

CE TO WHITE HOUSE — The Cleveland firm of consulting engineers, Robert Heller & Associates, has been retained to provide the President with more office space without changing "the traditional lines, simple dignity, and sense of permanency" of the White House. An auditorium large enough for presidential news conferences and meetings with large groups is one of the goals of the study now under way.

SOIL SOLIDIFIERS — Aid from the chemists in solving problems plaguing the building of roads and dams was disclosed at last month's meeting of the American Chemical Society. Soil stabilizers have been developed and tested that will make possible better roads at lower construction costs and that will solve seepage problems in dams, tunnels, and foundation walls. A sharp rise is likely in the next couple of years in the production and sale of new chemical soil stabilizers.

DOUBLE THE RATE — A New York State program for construction between now and 1963, with a cost tab on it of almost $2 billion, was recently discussed by State Comptroller Arthur Levitt. He pointed out that this includes only already authorized outlays and that the annual expenditure would be twice as large as the average for the preceding comparable period.

THROUGH THE TRANSIT — A reduction of 10% in accident rate represents an annual saving of about $1,250 for each 100 employees — so said Mr. T. J. Berk, Metro. Life to a recent meeting of AMA . . . . A group of L.A. builders purchased for $6.1 million the 875-acre Platt Ranch in the San Fernando Valley which they will convert into a $150-million subdivision and shopping center . . . . About one-third of the total engineering grads this year are in ROTC . . . . As of February 13, 1955, Utah became one of the select few — a debt-free state . . . . Fire losses in March totaled $88 million, the largest total for any month since the Livonia conflagration boosted the August 1953 total to $108 million . . . . The Alabama legislature has approved a $50 million program for construction of rural roads . . . . Merritt-Chapman & Scott was the low bidder on the twin-tube tunnel under Baltimore harbor. J. E. Greiner Co., Baltimore, is CE for the project.

ATOMS IN ACTION

UNDER AEC'S POWER DEMONSTRATION Reactor Program, four proposals have been made by public and private organizations for licenses to construct and operate major reactor installations. The Nuclear Power Group, spearheaded by Commonwealth Edison Co. of Chicago, proposes a boiling water reactor of 180,000 kw capacity to be completed in 1960. Yankee Atomic Electric Co. of Boston plans to build a 100,000 kw light water moderated and cooled reactor plant in western Massachusetts and to sell the electricity to the eleven member utilities in the group. A proposal for a fast breeder plant with 100,000 kw capacity, to be completed in 1958, came from a nine-company group. Eight of the companies are members of the Atomic Power Development Associates, Inc. and the ninth is Delaware Power & Light Co., a non-member. The fourth proposal came from Consumers Public Power District of Columbus, Nebr. and calls for a 75,000 kw sodium graphite reactor to be completed in 1959. Each of the four proposals is contingent on provision of adequate insurance coverage . . . Total cost of the four plants would come to about $150 million, according to AEC, of which the sponsors' share would be from 80 to 90 percent with the Government footing the rest of the bill.

WITH THESE FOUR LICENSE applications in hand and Consolidated Edison's application to build and operate a plant with its own funds, AEC is "beginning to begin" development of plans to issue and administer licenses. First step is establishment of a Division of Licensing to be headed by Harold L. Price as director. For the period while licensing regulations are being drafted, AEC has worked out an interim arrangement under which firms and institutions can engage in activities subject to licensing but not yet covered by formal regulations.

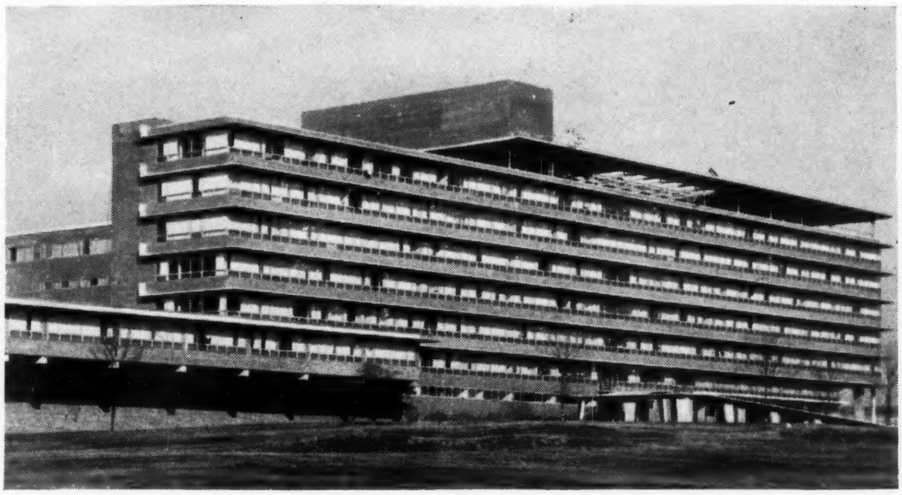
TESTS MADE by the Sanitary Engineering Branch of the Corps of Engineers indicate that radioactive water can be made safe for drinking within 30 minutes. Commercially available ion exchange resins are mixed in the contaminated water to capture radioactive ions and settle out.

WESTINGHOUSE AIR BRAKE CO. and Fluor Corp. have entered a joint contract with AEC for a preliminary study of the feasibility of a packaged power reactor for the military which will require no operating personnel and a minimum of routine maintenance . . . The Convair Division of General Dynamics Corp. is operating a small portable nuclear reactor at its Fort Worth plant in connection with development of nuclear propulsion for aircraft . . . Curtiss-Wright Corp. has announced a contract with the Air Force for design studies of the application of atomic power to aircraft . . . Baldwin-Lima-Hamilton Corp. and Denver & Rio Grande Railroad will evaluate the engineering, technical, and economic aspects of a "nuclear powered reciprocating engine" for possible use in locomotives, among other things. This study group has been given the go ahead by AEC under the Industrial Participation program.

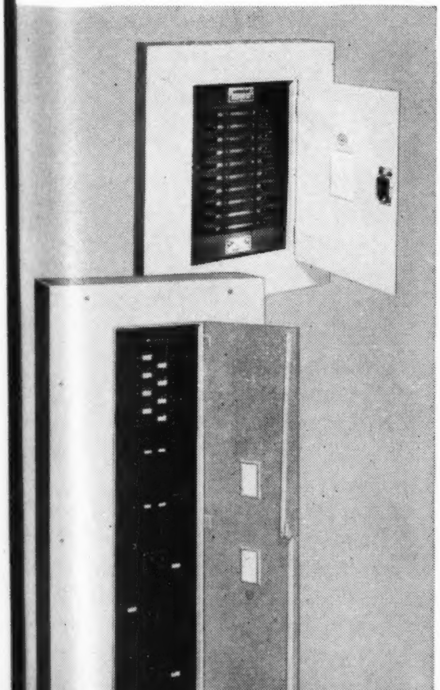
THE UN INTERNATIONAL Scientific Conference, scheduled for August 8-20 at Geneva, Switzerland, takes on new interest with the announcement that the U.S. will provide a $350,000 swimming pool research reactor as a major conference exhibit. Fuel for the Geneva reactor will be fuel grade uranium enriched in isotope 235 to about 20 percent—the type that other nations can draw from the 100 kilograms of uranium 235 the U.S. has allocated for research reactors in other countries.

WESTINGHOUSE ELECTRIC CORP. plans to spend $6½ million to build a nuclear materials test reactor—on its 550 acre site near Blairsville, Pa. if AEC OK's the site for the "reactor center" Westinghouse has in mind. When complete, the reactor is expected to have the largest physical capacity for full-scale testing of atomic power plant components of any test reactor in the U.S. ▲▲

"This same team of electrical specialists designed the power distribution system for the Lankenau Hospital in Philadelphia . . ."



Circuit breaker panelboards assure maximum branch protection in Lankenau Hospital*



Safety and dependability of electrical service at the utilization level are assured in the Lankenau Hospital by the use of Westinghouse circuit breaker panelboards. Possible damage to operating equipment through short circuit or power overload is eliminated.

The great majority of service interruptions is caused by momentary overloads or short circuits. In these cases, the circuit breaker handle can be flipped back to the "On" position to restore service. However, if a sustained overload or short circuit occurs, it is impossible to close the circuit, since it is trip-free.

Type NLAB circuit breaker panelboards, shown at top left, provide positive circuit protection to all lighting and small appliance services in the hospital.

Type CDP convertible distribution panelboards, bottom left, serve other power loads in the building. These panelboards, with engineered convertible design built in, adapt easily to changing load requirements.

Complete electrical installation by Harry F. Ortlip Co., Philadelphia, Pa.

*The Lankenau Hospital, designed by Architect Vincent G. Kling, AIA, Philadelphia, was the nation's outstanding hospital of 1954. It received the National First Honor Award in Hospital Architecture from the American Institute of Architects.

DP-5013-E

YOU CAN BE **SURE**... IF IT'S

Westinghouse

A TABLOID OF "BEFORE AND AFTER." MINER AT LEFT IS USING OLD TYPE SHOVEL, WEARS SOFT BERET, AND GETS LIGHT FROM CARBIDE LAMP. COMPARE WITH NEW EQUIPMENT, RIGHT.

Getting More Coal From Austrian Mines

WALTER T. BUHL
Consulting Engineer

Walter T. Buhl, a native of Utica, N.Y., was graduated from the University of Michigan, 1935, with a degree in Engineering Physics. He worked at Physicist Research Co. and later at SKF Industries. He was chief engineer with Jack & Heintz until 1949, when he went with Whirlpool Corp. to set up their research department. In 1952, he was appointed Chief of Technical Assistance in Austria for the Foreign Operations Agency. Currently he is a consulting engineer registered in Michigan.

IT BECAME EVIDENT in 1949-50 that the dollar aid of the Marshall Plan was not accomplishing all that had been hoped. European industry was being rebuilt but largely on a pre-war basis. One of the sore spots was in the coal industry, and as Chief of Productivity and Technical Assistance, for the Mutual Security Agency of the United States, I had the job of trying to solve the extremely serious coal mining problem in Austria.

At first this looked simple. If each miner produced 20 percent more coal, there would be plenty for all. Unfortunately, this was the approach that had been used in England, and in spite of vehement urging, the productivity of the British miner had risen very little — and very slowly. I knew nothing about mining coal, but I was experienced in management and the handling of labor. Fortunately, I found I could borrow Leon Crouse, who knew plenty about coal, people, and mining. We teamed up in February of 1952 and got right to work.

In looking over the Austrian situation, we found that all mines are state owned, through Kohlenholding A G, which operates and acts as a private

corporation. We also learned that in Austria, there is only one mining school, and most managers and engineers are graduates of this school. Quite often they are fraternity brothers. On the other hand, the mines are widely separated and the managements were quite isolated. There was little chance for transfer of technical information from one mine to another. Only occasional meetings of management were held in Vienna.

Some of these mines have been operated for 150 years. The coal is a lignite, running from 34-percent ash to excellent grades of 3-percent ash. Deposits range from open pits with 150-ft seams to deep mining at 1000 feet. In general the seams lie horizontally with slight waviness, and they come in threes, the top seam being 20-in., the middle 40-in., and the bottom seam somewhere around 48-in. thick. These are separated by roughly 18 inches of soft wet clay. Over and under the seams lie gravel and blue clay, usually containing plenty of water. In the deeper mines there is a layer of quicksand, at varying depths, but usually one-half way down — somewhere around 400 to 600 feet.

The Problem

During the 1930's, which was a desperate economic period in Austria, local coal industries had almost ceased to exist. With the Anschluss to Germany in 1938, the industry was partly revived in preparation for war. It was recognized that local production of lignite would lighten the transportation problems to be faced during a war. However, this revival was on an "add more men" basis. Little was done to modernize machinery, mining methods, or management.

The war and post war years continued the isolation of these managements groups from the progress taking place in this industry. By 1950 this isolation had lasted 15 years. It is no wonder that productivity was low even for Europe.

Crouse, who had helped with the mechanization of American mines when he was manager of Revlock, also had considerable foreign experience. This included Korea, Pas de Calais of France, and the Ruhr. He immediately recognized the true problem and put in a call for assistance. To cover the mines of Austria, we figured we would need at least two men. We preferred men who had helped in the mechanization of their own mines and who understood the change of philosophy that had to precede mechanization. Accordingly, we requested and got on loan from the United States Bureau of Mines, Jim MacDonald and Bill Chick.

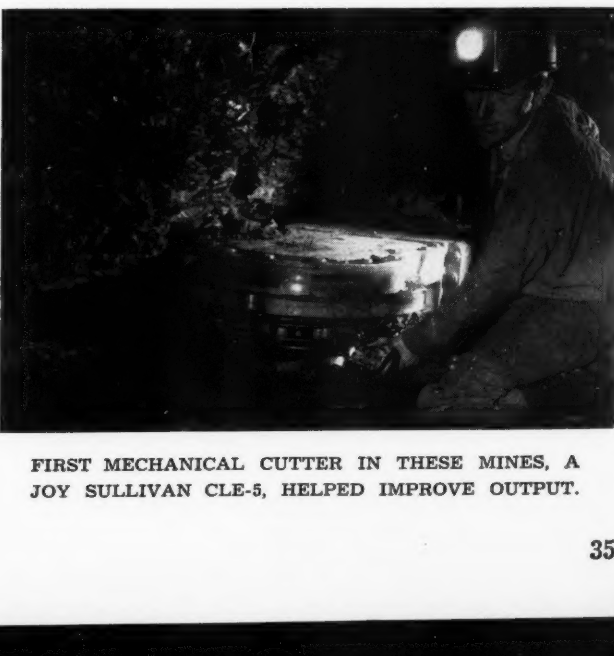
It was agreed that the real problem lay with mine managements that neither managed nor knew the tools available for the job. By tools of management we were thinking of business methods as well as machines. This was quite similar to the situation in this country 25 years ago. Here at home unionization and depressed business conditions forced management to learn its job. How were we to provide the motivation in a nationalized and protected industry where all the managers were graduated from the same school? Prestige and appeal to pride seemed to be the best tools to get a little competition started. With this as an entering wedge, it seemed possible to get them to concentrate on fewer working faces and to introduce new machines. If this were done successfully, the increase in coal production might allow some real competition between these nationalized mines and urge them on toward reduction of costs.

Approaching a Solution

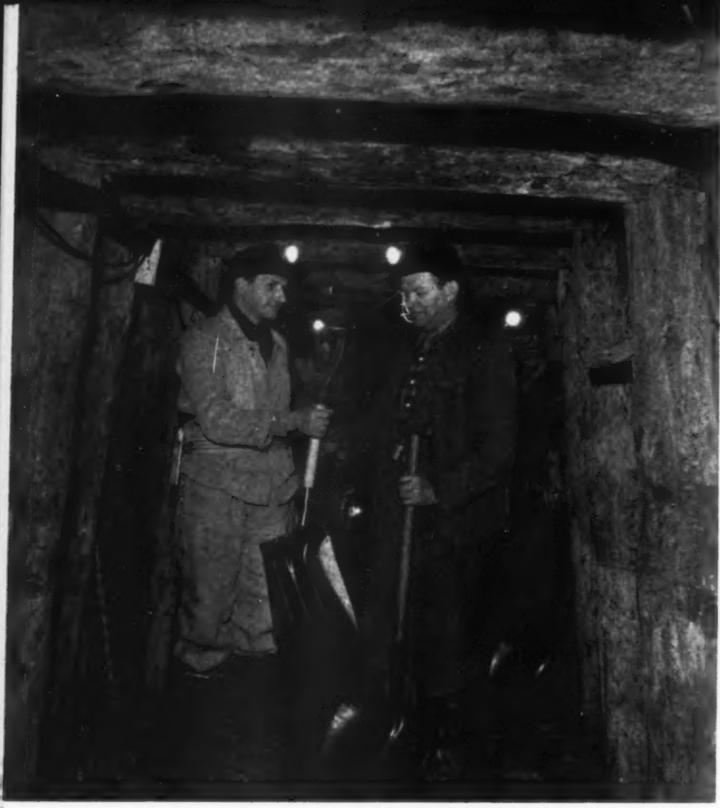
Our first move was to force the mine managers themselves to go underground — by requesting them to show our men through their mines. Further, at a general conference at the mining school, in Leoben, the managers were invited to visit each others mines. All were found eager to make these visits. Then a trip was arranged for six managers and Kohlenholding officials through some of the mines of the German Ruhr and two mines in France. It was hoped that this would show how even more difficult conditions were overcome in other countries—where the productivity was higher and where there was more use of machinery. Twelve men came to the United States on a trip through an assortment of our mines. This group was made up of men from management, engineering, and the unions.

These trips were real eye-openers, especially the six weeks visit to the United States. John L. Lewis was the most impressive personality the visitors met and the one that hammered most effectively for mechanized underground operations. His stand particularly impressed the union men.

We discovered a number of new, war surplus Joy Sullivan CLE-5 Coal Cutters in storage. These machines had been bought on speculation and had not been built for Austrian mines, but we thought they



FIRST MECHANICAL CUTTER IN THESE MINES, A JOY SULLIVAN CLE-5, HELPED IMPROVE OUTPUT.



THE AUTHOR (LEFT) AND MANAGING DIRECTOR OF SAKOG COMPARE THE OLD AND NEW SHOVEL DESIGNS.

would work quite effectively. On inquiry we were informed that they would not work in Austrian mines, but this opinion was based only on a theoretical analysis of the machines and not on an actual test. Tom MacDonald pursuaded one mine manager to give one of these machines a trial, despite the mine engineer's assurance that it would not work. Just to be safe, we got a manufacturer's engineer from England to put the machine into operation.

We were very puzzled as to why the Austrians were so sure we would have trouble with this machine. It did not take long to find out. The Austrian method of mining favors long wall faces. They would shoot the coal out of the solid and hand shovel it to the terminal point in the heading, where it was loaded in the cars. We put the demonstrator to work to undercut a 100-meter face to a depth of two meters in 45 minutes. As the cutter moved along the long face, holes were drilled and explosives loaded, so the shot was made within five minutes of the cut. Then we had 380 tons of coal.

Within two hours we were in real trouble. It was quite apparent that the transportation system of the mine could not handle such a high volume of coal from one face. Because we could not clear the face, control of the roof was lost, and the following day the face had to be abandoned.

On a new face we tried again with better results, but again lost control for the same reason.

Instead of trying to solve this transportation difficulty ourselves, we got the Austrian equipment builders, mine engineers, and management men together and had them work over the problem. Their solution was quite different from the one we would have proposed, but it turned out to be quite effective. They designed, built, and installed shaker conveyors along the face. These fed a belt conveyor in the heading, which took the coal to a loading point for transfer to cars. With this arrangement and a shortening of the cutter bar to 4½ feet, it was possible to get the face on a schedule calling for a cyclical advance of one cut per day.

The miners were really happy with this. They could move a lot more coal with considerably less physical effort. We imported short handled shovels from the United States, and loaned the miners some cap lamps and hard hats.

Every mine sent observers to this one face. They saw this machine and its attendant conveyors in operation producing coal at the highest output per man-shift of any face in the country.

A Real Opportunity

In the northern part of the country, there was a large mine (SAKOG) which had started production but which was not really producing for a variety of reasons. Properly managed this property could produce a fine grade of clean lignite very cheaply in spite of the large debt that had to be serviced. This looked like a real opportunity to put on a demonstration. Because of the quality of the product, this demonstration would allow us to bring competitive pressure on some of the other mines. Bill Chick concentrated his work at this location and found that there were a lot of little factors that would have to be worked on in order to bring production up. Improved ventilation and better track maintenance worked wonders. On paper these seem minor, but the better the ventilation of the face, the quicker the miners can go back after a shot is made. There were instances where miners could not get back to work until after a two-hour wait for the smoke to clear. Better ventilation cut this down to 10 minutes.

Similarly, with improved track maintenance the coal traveled faster, and the miners were hauled to work in about one-third the time. Simple things, like the planning of waste and rock disposal underground rather than hauling it above permitted every car coming up to carry coal rather than trash.

Electric cap lamps instead of the hand carbide lamps gave an immediate jump in output. Much to our surprise it was found that these lamps could be rented for less than the carbide in the old lamps.

While American shovels for low coal were better than those in use, they were not the ultimate. They did cause the local engineers to start experimenting, with the result that a very good shovel was developed that was suited to these mines.

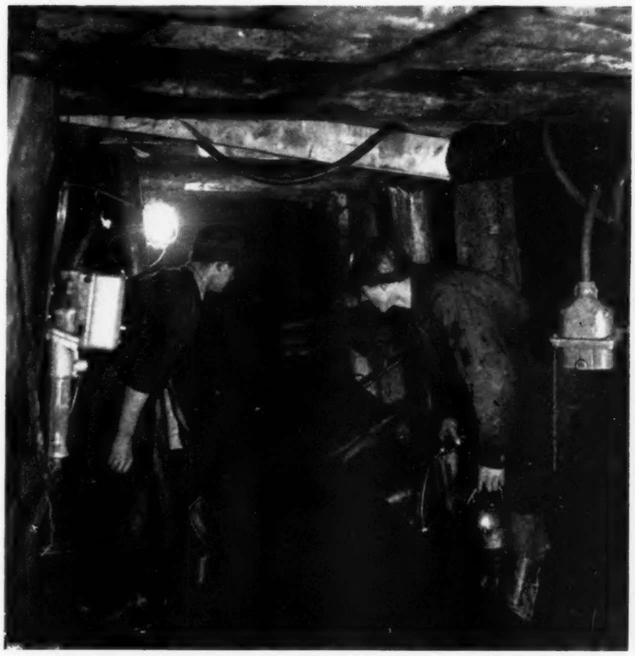
European power tools tend to be small and underpowered. The CLE-5's showed them how fast big machines worked. Equally as important was

the fact that cuttings from these big machines were of a more salable size than the dust made by the small machines. One cut with the big machines will produce as much as 15 tons of cuttings. It was also found that the more the cutting machines were used, the less explosive was needed, and a considerable saving in cost per ton was achieved this way.

Steel Props

Besides using bigger machines, conveyors, and better hand tools at the face, this mine introduced the use of steel mine props. The steel props had not worked to any advantage before because of the rather haphazard work arrangements at the face. With the new mechanized methods it was necessary to have more room and to be able to move roof supports quickly. Steel props become of prime importance. Wooden props were non-recoverable because of the terrific roof pressures, slow face advance, and the soft bottom. The saving in timbering costs was appreciable. These improvements allowed the management to concentrate on a fewer number of faces and to advance them much more rapidly. Furthermore Bill Chick insisted on an active development program of new faces so that as a crew worked out an area, they would always find a new face ready for them to move to.

ROOF BOLTING WAS ENTIRELY NEW TO EUROPE. AUSTRIAN MINES WERE FIRST TO MAKE USE OF IT.



BELT CONVEYOR WAS VITAL TO PROJECT BECAUSE MOVING COAL FROM THE FACE WAS A BOTTLENECK.

One technical advance made at this mine was the introduction of roof bolting, which was entirely new to Europe. It had been discussed in several countries, but Austria was the first one to use it to any extent. This technique had been seen on the visit to the United States by one of the engineers.

Wage Rates

Obviously, it takes a multitude of these little things to improve mine production. But it is most necessary to get the management and the miners coming up with their own improvements. The management quickly realized that one potential problem was in pay rates. The men were paid by the ton at a piece rate adjusted for the conditions at the different faces. In order to stay clear of the stigma and the difficulties resulting from downward adjustment of the per ton rate as production increased, the miners were persuaded to go over to a day rate 40-percent higher than their existing take home pay. This was put into effect before all the improvements began to really pay off. Actually, the new ideas could not pay off until the men were in a position where the increased output would be to their advantage.

New Markets

When a mine, such as SAKOG, climbs from 250 tons per day to 1250 tons per day in a year, a market is needed. As part of the over-all program for technical assistance in Austria, five American marketing specialists put on a three-week seminar, in Gmunden. Although this seminar was for all types

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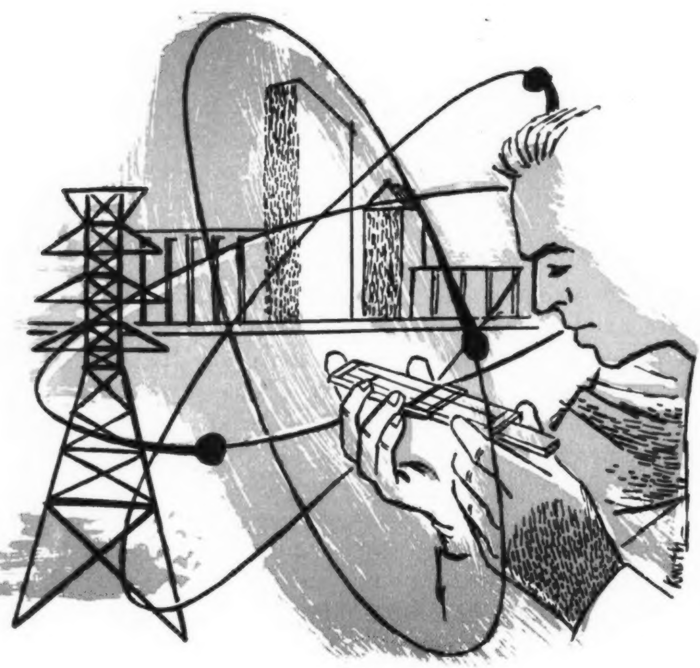
Why We Are In Atomic Energy



C. R. BARTHELEMY
Chief Mechanical Engineer
Pioneer Service & Engrg. Co.

In 1928, Mr. Barthelemy received his B. S. in Mechanical Engineering at the University of Minnesota. Following this he was associated with the Northern States Power Co. in the Power Generation Department. Since 1946 he has been affiliated with Pioneer Service & Engineering Co., as mechanical engineer in the design of steam electric generating stations, and he has been closely associated with the nuclear power study group composed of Pioneer Service & Engineering Co., Foster Wheeler Corp. and Diamond Alkali Co. In 1954 Mr. Barthelemy was appointed to his present position of Chief Mechanical Engineer.

SINCE the beginning of time, energy has been the key to man's progress. Today we stand on the threshold of what may be a bright new era in the peaceful application of an awe-inspiring form of energy—in the nucleus of the atom. From the tremendous wartime development for bomb production, we now turn to the translation of this basic knowledge to the peacetime needs of man. The dissatisfaction with the *status quo* is at work again in the minds of men of scientific inclination. They are working on the conversion processes required to realize the potential in nuclear energy.

Keeping Up With Scientific Advances

We, as consulting engineers, have been asked what factors impelled us to become interested in atomic energy. One of the reasons is inherent curiosity. All engineers are seeking to determine what atomic energy is going to mean to them. A more basic one for us is that through fifty odd years we have been serving the power industry in the development of power producing facilities. During this period it has been our habit, indeed an obligation, to look ahead and prepare for and take advantage of the advances in this science. So we can say we are in atomic energy because it comes naturally.

However, there is further compulsion. The utilization of nuclear energy for power production represents, in some respects, a more drastic departure from accustomed practice than has been encountered in many years. Accordingly, we find ourselves absorbed in a deep consideration of the impact that nuclear energy will have upon our times, and more particularly, upon the processes of energy conversion for power production.

One of the normal questions asked of us as consultants is, "When shall I take atomic energy into account in my planning for the future?" Today, as the construction of full-scale nuclear power plants is just beginning, the question may seem premature. But it is certain to be asked with increasing frequency as time passes, and numerous factors are bound up in the answer.

Questions We Must Answer

An astute businessman wants to know when he can expect nuclear power plants of commercial reliability and how soon they will be economically

competitive. He desires a knowledge of the requirements as to location and operation that will be imposed upon him because he will have to cope with radioactivity and its attendant hazards. In addition, while it may not be of immediate concern, there is the question of the reserve supply of conventional fuels. Since present-day thermal power plants are built to serve for 30 to 40 years, it seems perfectly logical to give some attention to all of these questions as new plans are made.

By close identification with the atomic energy development program we believe we can keep abreast of the trends. This knowledge will lead to definite answers, not guesses, to the host of questions.

Designing Nuclear Plants

As development progresses and the years pass, nuclear power will supplement in increasing amount the power produced by conventional means. This leads to the second major reason why we, as consulting engineers, are in atomic energy—it is quite probable we will be called upon to design such plants.

Here is the merging point of many talents. The modern boilers that produce the steam to drive turbine generators are the developments of groups of engineers specializing in this field. Progress with nuclear reactors, in our opinion, will be handled on a somewhat similar commercial plane. Just as today we, who are engineers and designers, must know what we can and what we cannot do with boilers and associated equipment, so do we believe that we must prepare ourselves for a comparable responsibility when the nuclear power plant becomes a commercial reality. It has been our conviction that we should not wait until such plants are with us in substantial number.

Design Problems

Today, there are varying opinions on which reactor system, among many, will prove best. In our studies, as well as those of others, the field is narrowing to a few. Each of these is surrounded by problems of substantial magnitude. Materials, little used before the advent of the atomic energy program, are assuming great importance. Their behavior under conditions encountered in nuclear reactors must be determined. New equipment designs are required in many instances. Unique procedures must be developed to enable the maintenance of plants in a practical manner. Waste is a very special problem.

These and many other points are part of the whole fabric of the development program on the use of nuclear energy for power production. As we come to the point of choosing equipment for the nuclear power plant, we will require, as we do in conventional plants today, the perspective to reach sound judgments. By participation in the program as it develops, we not only build the store of knowledge that one day will prove valuable in engineering and design, but we gain the perspective that will aid in its interpretation and proper application.

Practical Considerations

As consulting engineers engaged primarily in service to public utility companies, there is yet another reason for being associated with the program. It was felt that we could make some contribution to efforts directed toward the use of nuclear energy for commercial power production.

Many fine scientific minds have been deeply absorbed in bringing about the understanding and demonstration of the controllable release of the tremendous energy stored within the atom. The nuclear relationships involved created the need for a new group of engineers. These men have brought nuclear energy to the point where its application to power production holds promise. Now numerous questions arise having to do with its compatibility with the conditions encountered in a commercial power system.

What happens when the load on a turbine generator is suddenly lost? What happens if a great load is suddenly imposed? Reliability and continuity of operation are important in the commercial installation. Nuclear power plants must be designed to insure this to the greatest possible degree. Commercial plants must be susceptible to maintenance with the minimum of down time and lowest practicable cost. It is in matters of this nature that the practical knowledge of the consulting engineer engaged in service to the power industry can be blended into the nuclear power development program to advantage.

In an atmosphere so filled with dramatic development, these practical facets may seem to be overshadowed. Yet we know from experience that the community of ideas is valued. So a third reason for being in atomic energy is to contribute by helping to weave into the development program the "feel" of the practical operating problems that will be encountered by nuclear power plants in commercial generating systems.

Summary

Through more than two years of association with the nuclear energy program, we have sought to learn in order that we might appraise and plan. We have sought to learn so that we might develop knowledge, perspective, and judgment for the day when we may be engaged in the design of a nuclear plant for commercial service. At the same time, we have endeavored to supplement the assembly of technological material with information gained from experience in our particular field. We and our associates look upon our work as a valuable experience and a contribution to the progress toward the goal of commercial nuclear power. ▲▲

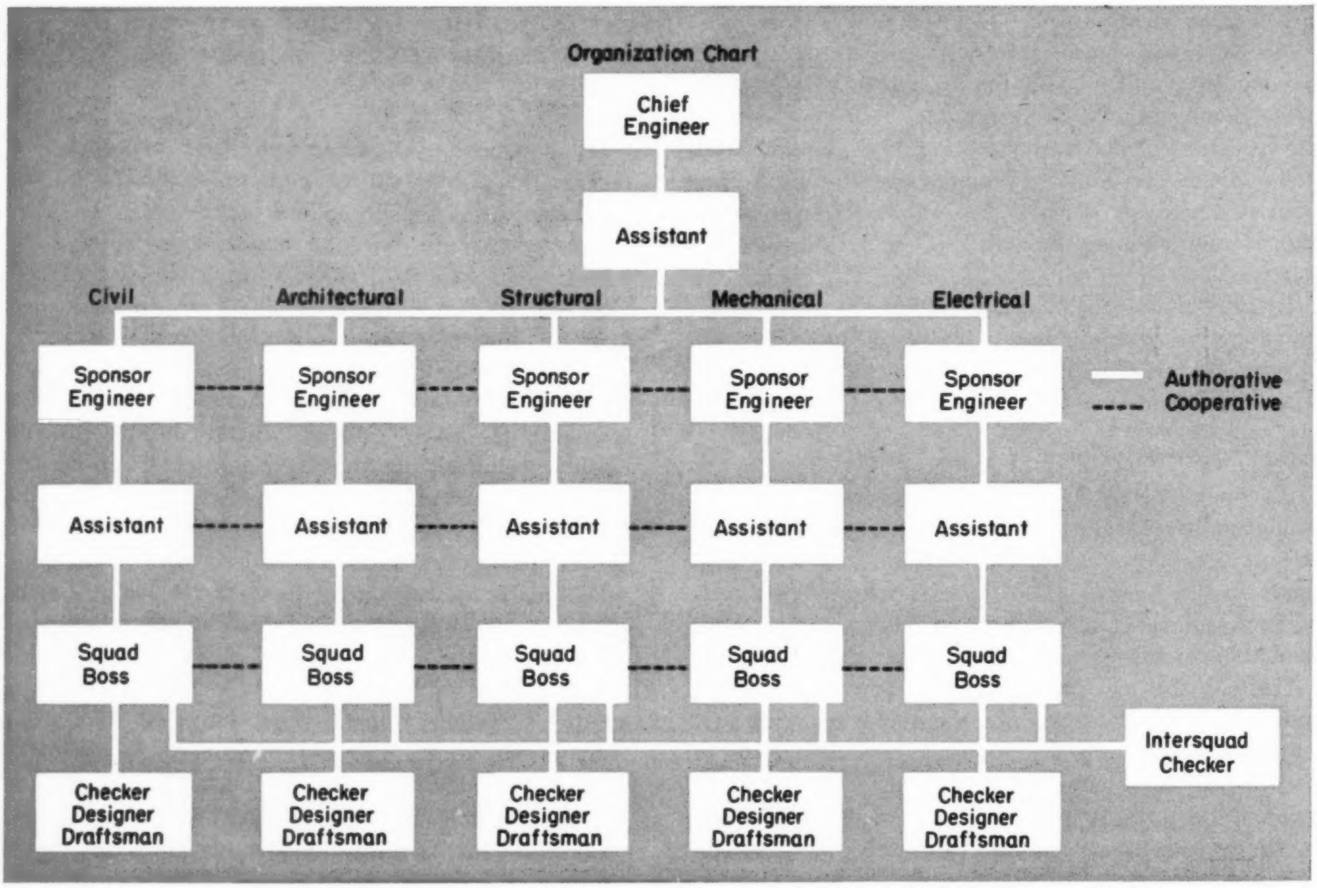


FIG. 1 — A TYPICAL ORGANIZATION CHART FOR A CONSULTING ENGINEERING FIRM ON A CONSTRUCTION PROJECT.

Office Standards and Organization

For The Consulting Engineer

RAYMOND DITTRICH
Consulting Engineer

CP exclusive

STANDARDS are the very foundation of a successful engineering firm. Every company claims to have office standards, but it is not unusual to find as many standards as there are departments or engineers. This nullifies the very purpose of the standards, rendering them worthless.

The first and most important step is the organization chart. Fig. 1 shows a practical plan. This scheme must be enforced in order to be of any value. For instance, no designer should be allowed to ask an Assistant Engineer for instruction, by-passing his Squad Boss. The Assistant Chief Engineer should never give any information to the Squad Boss without the knowledge of the Sponsor Engineer.

On the organization chart it will be noted that each department is headed by a Sponsor Engineer. This is known as a vertical division. Each engineer handles only matters related to his department. Except for small jobs, this method is best.

Duties of Engineers

All of the engineers in the organization should understand their duties.

Chief Engineer — Generally supervises the work; handles major conferences with client and manufacturers; makes recommendations concerning bidders and contractors; makes periodic checks of office and field progress charts; and checks expenses.

Assistant Chief Engineer — Directs cooperation between sponsor engineers; prepares construction progress charts; checks office progress charts; distributes all incoming mail; checks all outgoing letters; and hires men.

Sponsor Engineer — Handles all correspondence

Manufacturers Drawings Sheet__ of__

Client____________ Job No.______ Location____________

Manufacturer	Title	No.	Order No.	File No.	Rev	Rc'd	Rt'd	Rev	Rc'd	Rt'd	Rev	Rc'd	Rt'd	Remarks

FIG. 2 — THIS FORM IS FILLED OUT BY THE SQUAD BOSS OR ASSISTANT ENGINEER AND PRINT REVISIONS NOTED.

and engineering matters such as major design work and calculations; determines and submits to client lists of proposed equipment and layouts; contacts manufacturers and contractors; and checks field and office progress charts.

Assistant Sponsor Engineer — Prepares office progress chart; makes cost and manhour estimates; writes specifications; prepares drawing and manhour lists; and handles manufacturers' drawings as well as the design problems.

Squad Boss — Takes care of drawing list and manufacturers' schedules; guides and gives instructions to his men; and is responsible for the catalogue file, manufacturers' drawing file, and all blueprints needed on the project.

Job Books

Every engineering job requires that all important information be recorded in well-planned job books. These books should be kept up to date and in such a manner that anybody needing information can locate it easily. There are engineers who consider this procedure a waste of time; they "remember" and then finally admit, "I forgot." This constitutes too often the real stumbling block for an otherwise efficient firm. Eight job books will be needed for each project. Ring-binders are generally used.

Book No. 1 - Correspondence — This book should have subtitles for Client, Manufacturers, Field Office, and Contractors. Large jobs need additional subtitles. When letters contain references to several subjects, extra copies should be made and each filed under a proper heading.

Book No. 2 - Technical Data — All calculations, cost estimates, conference notes, and design sketches should be filed under the proper headings such as "Boilers," "Pumps," "Piping," or "Motors."

Estimates should be under the supervision of one competent man with thorough experience. Union rules, prevailing local labor rates, cost of manufacturers' supervision, delays due to weather conditions, and many other circumstances enter into a really good estimate.

Book No. 3 - Specifications — These should be filed under descriptive headings, and only the latest copies should be retained in this book. One copy of any superseded specifications should be placed in the Record file (Book No. 5).

Book No. 4 - Purchases — This book deserves utmost care. Forms shown in Fig's. 2, 3, and 4 should be used. The invitation for bids should call for four prints. Print 1 is the record copy, Print 2 is to be returned to the manufacturer, Print 3 is for the drafting room, and Print 4 is for the client.

A comparison of bids should be made by the Assistant Engineer and submitted to the client with a recommendation. The successful bidder should be requested to send six sets of prints—one set each for Records, Design Department, Field Engineer, and Contractors, and two for the client.

All incoming prints should be filed in numerical order with numbered division sheets inserted. Upon

Manufacturers Drawings Sheet__ of___

Client____________ Job No.______ Location____________

Provided by: "H"-Home Office, "C"-Client, "M"-Manufacturer, "F"-Field, "Ct"-Contractor

Manufacturer	Title	No.	File No.	Item No.	Prov.

FIG. 3 — INVITATIONS FOR BIDS CALL FOR FOUR SETS OF BLUEPRINTS. RECORDS ARE KEPT ON THIS TYPE OF FORM.

Material Order Schedule Sheet__ of__

Client________ Job No.______ Location________

Provided by: "H"-Home Office, "C"-Client, "M"-Manufacturer, "F"-Field, "Ct"- Contractor

Item	Manufacturer	Description	Order No	Prov	Date to be		Actual			Rev
					Ord	Del	Ord	Prom	Ship	

FIG. 4

Drawing Progress Chart

Client________ Job No.______ Location________

No.	Title	Percent						Issued					
		Due	15	25	50	75	100	0	1	2	3	4	5

FIG. 5

Manhour Record

Client________ Job No.______ Location________

Dwg No.	Title	Design	Checking	Total

FIG. 6

Bill of Material No.______

Client________ Job No.______ Location________

Provided by: "H"-Home Office, "C"-Client, "M"-Manufacturer, "F"-Field, "Ct"-Contractor

Item	Quan	Description	Order No.	Prov	Rev

FIG. 7

FIG. 4-7 — SAMPLES OF FOUR OF THE MORE IMPORTANT FORMS NEEDED ON MOST ENGINEERING PROJECTS.

receipt of revised prints, the previous issues should be destroyed except the record copy, which should be marked "void."

The Sponsor Engineer should give these prints a superficial check as to performance and suitability. The Assistant Engineer should add the proper title on the print, for the manufacturer's title is usually too general. The manufacturer's print might read, "Motor, 5hp, 440 v, 60 cycle" whereas the proper title should read, "Motor, 5hp, 440 v, 60 cycle, for sump pump No. 1."

The Assistant Engineer or Squad Boss should enter the print on forms such as are shown in Fig's. 2 and 3. He should give the print a detailed check as to dimensions, parts, and material. Desired changes should be marked on all prints in red pencil.

Book No. 5 - Records — This book is for the use of the Squad Boss. The Drawing Progress Chart, Fig. 5; Manhour Record, Fig. 6; and other pertinent information belong in this book.

When the scope of the work has been agreed upon between the client and the engineering firm the Assistant Engineer should prepare a list of drawings and manhours required for each drawing. Using the Construction Progress Chart as a base, the necessary number of designers, draftsmen, and checkers for the project can be determined.

Regarding the number of men, quality not quantity counts. True, company policy often makes it difficult if not impossible to hire a high priced man, but it is undoubtedly more economical to have one experienced man rather than two less capable.

The number of manhours required for each drawing depends upon the type of drawing for which the client is willing to pay. There are three distinct types of drawings—Contractor's, Engineer's, and Client's.

The Contractor's Drawings contain just enough information to enable the contractor to do the job. The Engineer's Drawings contain additional information not needed by the contractor but of value to the engineers. The Client's Drawings give all necessary details of construction. These are of great value to the client for maintenance or expansion.

To save time and money, engineering firms often refer to manufacturers' drawings for certain details. This is dangerous and should not be done except when these details are not subject to changes.

The average number of manhours per drawing, including checking but excluding supervision, should be 60 hours for Contractor's type, 80 hours for Engineer's Drawings, and 120 hours for the Client's.

The Chief Engineer and Sponsor Engineer should check the drawing list. If a perfectly legible drawing can be made to ⅛-in. scale, why draw it to ¼-in. scale at nearly four times the cost?

An experienced engineer will be able to determine in advance the correct title for each drawing. The drawing numbers should be assigned so that it is possible to keep together similar subjects such as: equipment location plans, piping layouts, and flow diagrams for the mechanical department; single line diagrams, equipment layouts, lighting, conduit plans, and wiring diagrams for the electrical squad.

Very few drawings are made without symbols. The fact that manufacturers and national standard organizations are in disagreement can and often does cause utter confusion unless all departments cooperate. To overcome this each department should have a key sheet illustrating and explaining symbols.

Book No. 6 - Drafting — This book is also for the use of the Squad Boss. Information on design, free hand sketches, and notes on requested changes belong in this book.

Book No. 7 - Bills of Material — This book is seldom, if ever, needed by the civil, architectural, and structural departments because the material is either summarized on each drawing or on special sheets. It is, however, of great value to the mechanical and electrical departments where there is a great variety of material appearing on more than one drawing.

A list of item numbers for standard material should be prepared. Figs. 7 and 8 show standard forms for a Bill of Material and Summary of Material. The Bill of Material Number shown on Fig.

7 should correspond with the Drawing Number of the print for which it has been prepared. Each item should be fully described as to catalog number and special features. Its real value becomes apparent when reordering or when a bank demands detailed costs before granting a loan.

Book No. 8 - Conduit Schedule — Fig. 9 shows a standard form of wire and conduit schedule for use in the electrical department.

Catalogs

No design department can exist without catalogs. Catalogs not properly filed will result in a considerable loss of time and money. The alphabetical file is widely used, though it is a poor system for the average firm. A corner grocer never would put Bakers Shoe Polish alongside Bakers Chocolate simply because the manufacturers have similar names. No engineer or designer should be expected to remember the names of all manufacturers of lighting fixtures, pipe fittings, and boilers. A catalog file by subject is the answer.

Personnel

Volumes have been written on how to organize. However, there are some special considerations for engineering firms. The Personnel Manager seldom has enough technical background to evaluate the engineering ability of a candidate for employment. If preliminary screening indicates that a man has the necessary qualifications, he should be interviewed by the Sponsor Engineer before final approval.

The recent graduate with little experience requires the patient help of the Squad Boss, Assistant Engineer, and Sponsor Engineer. Generally speaking, it takes about two months before such a man is of value to the company.

The Squad Boss is one of the most important links in the chain of command. No matter how excellent the Chief or Sponsor Engineers may be, the project will suffer if the Squad Boss cannot deliver the drawings. The Squad Boss must be an example to his men. He must insist on punctuality, have the ability to get the most out of his men without undue driving, to give each man the job best suited to him, to give technical help without belittling, and to have an interest in the personal welfare of his men—in short, he should be a leader.

The Checker is too often considered a necessary evil whose sole duties consist of adding dimensions and signing his name. This attitude is both foolish and expensive if poor or insufficient checking allows errors to be found in the field or by the client. The Checker, to be worth his name, must have the ability to verify a drawings correctness in every detail. The Intersquad Checker must be responsible for interferences all along the line.

Every firm has a slightly different problem in organization and record keeping, but the solutions are generally similar. With a little study necessary adjustment and changes can be incorporated into this basic plan. There are differences based upon size of organization, extent of the project, type of project, and extent of field authority. All of these aspects as well as special client policy must be taken into account. However, this plan of organization and system of standards for record keeping has been widely used, and it has proved beneficial. ▲▲

FIG. 8—THIS STANDARD SUMMARY OF MATERIALS IS PREPARED AFTER THE BILLS OF MATERIALS (FIG. 7) ARE DONE.
FIG. 9—A STANDARD WIRE AND CONDUIT SCHEDULE USED IN ELECTRICAL DEPARTMENT AND FILED IN "BOOK NO. 8".

Summary of Material Sheet___ of_____

Client__________ Job No.______ Location__________

Provided by: "H"-Home Office, "C"-Client, "M"-Manufacturer, "F"-Field, "Ct"-Contractor

Item	Description	Prov	Total		Required						Remarks	Rev
			Req	Purch	B/M	Quan	B/M	Quan	B/M	Quan		

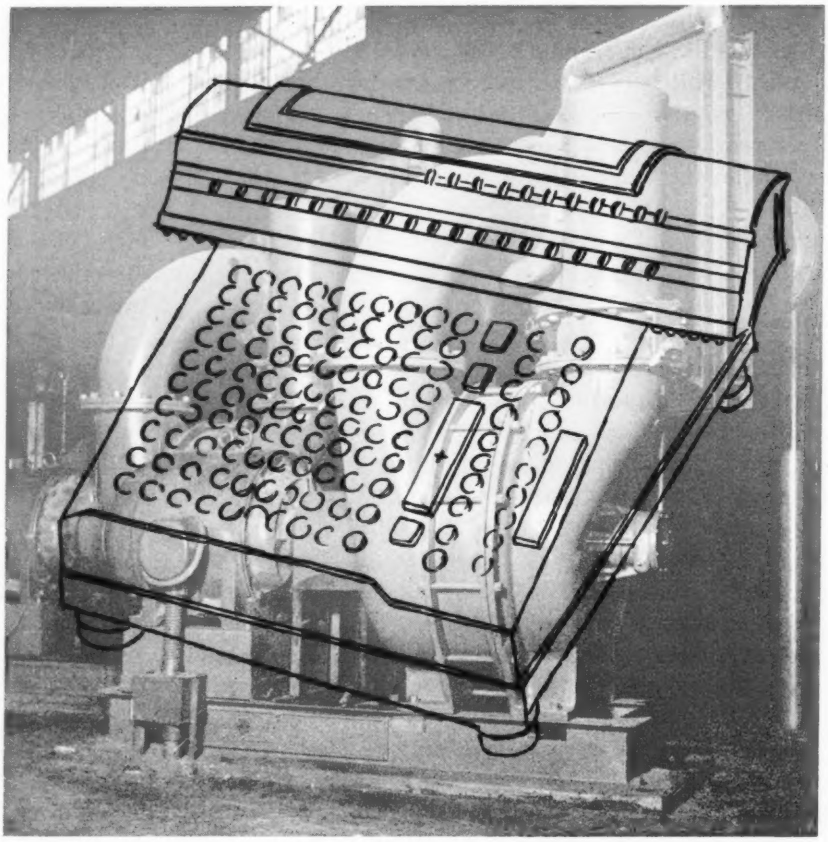
Wire and Conduit Schedule Sheet___of_____

Client__________ Job No.______ Location__________

Ref	Conduit			From	To	For	Wire			Length		Rev
	No	Size	Type				No	Size	Ins	Wire	Cdt	

HAROLD BLAND
Certified Public Accountant
Altschuler, Melvoin & Glasser

Harold Bland is a graduate of the University of Chicago. He also holds Bachelor and Masters degrees in Business Administration from Northwestern University, and he is a certified public accountant, licensed to practice in Illinois. His professional experience includes service with Arthur Andersen & Co., Independent Public Accountants; with A. G. Becker & Co., Inc., as a security analyst; and currently with Altschuler, Melvoin & Glasser, Independent Public Accountants. He also teaches accounting and finance evenings at Roosevelt University.



ECONOMICS STRONGLY INFLUENCE NEW EQUIPMENT SPECIFICATIONS.

Depreciation

An Economic Concept For Consultants

Ce exclusive

CONSULTING ENGINEERS must consider many factors when evaluating new equipment for their clients. One method used extensively in the past was the old rule of thumb — new equipment should recover its cost in five years. But this rule ignores many concepts that an accountant would consider in purchasing a new long-lived asset.

Depreciation Expense

In selecting a new machine, depreciation expense must be considered because the cost of the new equipment must be spread over its economic usefulness. This involves estimating the amount of net revenue the machine will produce and comparing this value with the cost of the machine to be purchased. For example, assume a machine will save $6000 annually in operating expenses for a 10-yr period, and it costs $10,000. Should such a machine be specified?

Under a straight line method of depreciation (interest is neglected for simplicity), the cost of the machine would be charged to expense at the rate of $1000 a year for ten years, and profits before taxes would amount to $5000 per year. The significant figure to consider, however, is the annual after-taxes profit. If the client's firm pays taxes at a rate of 50 percent, this value would be $2500. Thus, the annual rate of return on the investment of $10,000 is 25 percent, and the machine, unless the business contained an unusual amount of risk, might well be purchased.

When to Replace Old Assets With New

If all nondepreciation costs are designated as operating costs, a formula can be used to give an approximate idea of whether or not to replace existing long-lived assets with new ones. The formula can be expressed this way:

When the operating costs of the old asset exceed the total of the operating costs plus depreciation expense of the new asset, the new asset should be purchased (both operating costs and depreciation expense are computed at the estimated level of future production).

While this formula is not quite accurate because it does not consider return on the investment in the

new asset, it will serve for estimating purposes. However, the higher the cost and the longer the life of the new asset, the greater the error will be.

Book Value of Old Equipment

This formula excludes consideration of the book value of old assets—an item individuals other than accountants instinctively seem to regard as important. Actually, book value is of little significance. To a going business the economic value of long-lived equipment is determined not by book value but by the amount of net revenue (sales less operating costs such as labor and materials) the long-lived equipment will produce. Book value (original cost less accumulated depreciation) may vary widely from the economic value of a long-lived asset.

Assume your client has discontinued the manufacture of an article which had been produced with a special purpose machine that originally cost $10,000. If this special purpose machine had been depreciated in the financial statement at a 10-year rate for 8 years, its book value still would be $2000. It would be ludicrous to say that since the machine had two more years "value", it should not be taken out of the factory.

What has happened is that the accounting rate of depreciation was inadequate, resulting in an accounting overstatement of prior years' earnings. This should be corrected by either a deduction from earnings retained in the business or by a deduction from income depending on the size of the error involved and the principle of accounting the client uses.

In deciding, therefore, whether or not to replace long-lived assets, the book value of assets already owned is insignificant. "Value" is determined not by past deductions from income at an arbitrary rate, but by an estimate of the future income that results from owning and using property.

If book value of old equipment is insignificant, it follows that the depreciation expense on the old equipment is also unimportant. Once purchased, the entire cost of an asset is fully incurred. The rate of depreciation thereafter merely determines the length of time over which the cost is to be spread. Stated another way, depreciation expense is not considered for equipment already owned because no additional cost is incurred to realize the net revenue produced by the equipment.

On the other hand, additional cost is incurred when new equipment is purchased. Thus, the formula for determining the proper time to replace an asset ignores depreciation expense on the old asset but does consider depreciation expense on the new asset. This is not damaging in the decision to buy the new item. A new asset may be so much more efficient than an old one that its depreciation expense would be more than offset by savings in costs of production.

To illustrate, suppose a replacement item will cost $50,000, will be useful for 10 years, and will save $0.20 per unit of production (after taxes) in operating costs. Further, it is expected that 100,000 units will be produced per year. Since the annual savings in operating costs of $20,000 is four times the yearly depreciation of $5000, the new item probably should be purchased.

Accounting vs Economic Depreciation

In considering depreciation expense for a new asset, a distinction must be made between accounting rate depreciation and economic rate depreciation. For various reasons, primarily income tax benefits and conservative accounting, accounting rate depreciation is the rate of depreciation used in preparing financial statements. Economic rate depreciation is the depreciation rate used in deciding whether or not to buy a new long-lived asset. Obviously the length of economic usefulness is the determining factor. The subsequent rate of deducting the cost (accounting rate depreciation) is not important in the economic decision of whether or not to buy.

Table 1 shows the effect on profits of two companies using different accounting rates of depreciation. In both instances the consultant based his calculations for recommending the new asset on an economic rate of depreciation and an anticipated useful life of 10 years. Client A, however, depreciates machines of this type in the accounting records over a 5-yr period. Client B, on the other hand, uses a

TABLE 1 — COMPARISON OF PROFITS (BEFORE TAXES) WITH DIFFERENT ACCOUNTING RATES OF DEPRECIATION

	Client A	*Client B*
Savings in operating costs for first 5 years at $10,000 a year	$50,000	$50,000
Less depreciation expense		
A — Entire $50,000	50,000	—
B — One-half of $50,000	—	25,000
Accounting increase in profits for first 5 years	—	25,000
Savings in operating costs for second 5 years at $10,000 a year	50,000	50,000
Less depreciation expense		
A — Entire amount previously depreciated	—	—
B — Remainder of $50,000	—	25,000
Accounting increase in profits for second 5 years	50,000	25,000
Total accounting increase in profits for 10 years	50,000	50,000

10-yr rate of depreciation for the accounting records to conform with the consultant's estimate of useful life. Both machines cost $50,000 and save $10,000 in operating expenses per year.

From an economist's viewpoint, both companies ultimately show equally profitable results. The economic fact, however, that the companies have similar performance records is not reflected in their financial statements. The different accounting rates of depreciation resulted in Client B (10-percent rate) showing equal accounting profits in both 5-yr periods. Client A (20-percent rate) shows the entire accounting profit in the second 5-yr period.

Effect of Technological Progress

Consultants also must consider technological progress when evaluating equipment. The faster the rate of technological progress, the shorter is the time in which long-lived assets become obsolete. Yet cost must be spread over useful rather than physical life. Since a high rate of obsolescence reduces an asset's useful life, the estimated depreciation expense is higher in a rapidly changing technology.

Assume that a machine supposed to save $5000 a year (after taxes) in operating costs has a physical life of 25 years and costs $25,000. Depreciation expense is apparently $1000 a year, and the investment would seem to be justified. But further assume that although the asset will "last" for 25 years, in about 5 years technological progress will make the machine obsolete. Useful life becomes only 5 years in contrast to the physical life of 25 years. Spreading cost over 5 years gives a yearly depreciation expense of $5000, or just the savings in operating costs. This machine should not be purchased.

This example is, of course, a selected extreme. Major equipment manufacturers are well aware of the impact of changing technology. They know they must avoid wasteful practices to remain competitive. Often they can provide assistance by alerting consultants on future developments.

Effect of Future Prospects

Various other factors will influence a consulting engineer's decisions. Equipment is useful only to the extent of the demand for the product it produces. New equipment may be 20 times more efficient, but if it is idle it cannot demonstrate its efficiency. The best opportunity for reducing operating costs by replacing old equipment with new occurs when the new assets are expected to be used at or near their capacity.

General prosperity may affect decisions to replace assets in another, though indirect, way. While an asset's book value is unimportant economically, nevertheless, some clients may defer replacement of an asset with a high book value because of the necessity of adjusting the financial statements—even though the purchase would be economically justifiable. Management would much rather write off and replace an obsolete, yet undepreciated, asset in a lush year than it would in a mediocre or poor year.

Regulatory Commissions

That a particular industry is regulated by a public commission usually is of little concern. Only if the amount of assets being replaced is a significant percentage of the company's total assets would the possibility of subsequent regulatory action even be considered. In some instances, however, approval of the regulatory commission is necessary before purchase of a costly asset can be made.

Working Capital

A lack of working capital (current assets less current liabilities) may prevent the replacement of an asset. For example, many electric utilities pay out as much as 70 percent of earnings in dividends. This distribution of earnings, coupled with the usually higher cost of the new asset compared with the old (resulting from the price inflation beginning in 1941), may necessitate additional financing.

If the decision to buy new equipment was made by a narrow margin, the inconvenience of having to issue new securities may deter management. However, unless the assets being purchased are a significant percentage of the total assets of the company or the financial position of the company is very poor, financing would not be an important issue.

While the purchase of any specific piece of equipment will seldom present financial difficulty, there are other demands on a firm's funds. Management may want to reduce the firm's debt, or it may feel that its current assets need to be expanded—perhaps to handle additional business. If a piece of equipment is expected to provide a very generous return, it will probably be purchased. But if the return is not spectacular, new equipment may well have to compete with other business needs for the use of a firm's available funds.

Benefit of New Tax Law

As a result of the higher depreciation rates permitted by the new tax law*, clients will be able to postpone payment of Federal income taxes that would otherwise have been due. In effect, postponement of taxes provides a company with working capital in the years immediately following purchase of an asset. Prior to the new tax law, these funds would have gone to the government. Diminished requirements of additional capital in the immediate years after the purchase is a favorable factor in deciding whether or not to buy an asset. ▲▲

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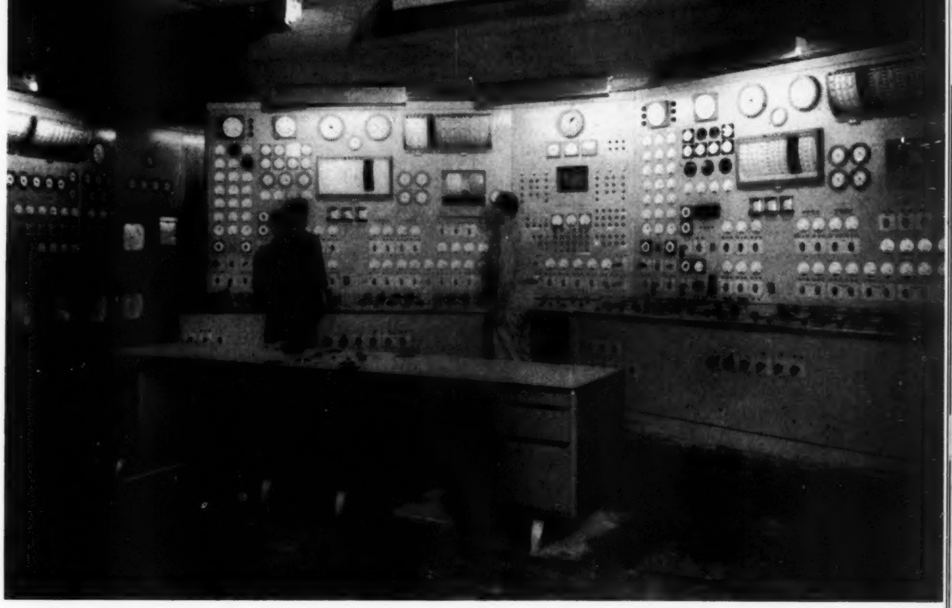
* A discussion of the effect of the depreciation provision in the new tax is given by Gerald J. Matchett in the "The Range Finder," *Consulting Engineer*, Aug., 1954, p. 20.



PANEL IN A CENTRAL CONTROL ROOM CONTAINS SUFFICIENT INSTRUMENTS AND CONTROLS TO MODULATE THE LOAD. THIS INCLUDES STARTING, STOPPING, AND QUICK STARTING OF UNITS AFTER FIELD PREPARATIONS.

A Simplified Symbol System

For Steam Plant Instruments and Controls

H. H. JOHNSON, Consolidated Edison Company of New York, Inc.

H. H. Johnson received his M. E. degree from Stevens Institute of Technology in 1925. Since graduation, he has been employed continuously by Consolidated Edison Company of New York, Inc., working on mechanical testing, power plant operation, system operation, and mechanical engineering. At present, he is Engineer-in-Charge of Instrumentation and Control on New Installations.

OVER THE LAST HALF CENTURY, the number of instruments and devices required for measurement and for control of a steam power plant has increased many times. To give some quantitative idea, the centralized control room in a typical modern two-unit plant—rated at 360 mw—contains the following equipment for operating, performance recording, and testing:

¶ 145 control handles, switches, and valves.
¶ 258 indicators.
¶ 47 recorders with 94 records of trends.
¶ 9 recorders with 13 turbine performance records.
¶ 13 monitors supervising 410 temperatures.
¶ 217 alarm lights.
¶ 398 lights for indicating the position of valves, switches, and various other system components.
¶ 4 communication systems including: telephone system, local; telephone system, external to system operator; public address system, covering entire plant; and emergency short wave, two-way radio to system operator. In addition, there is local instrumentation for the use of patrol operators and maintenance mechanics, as well as for testing. A total of 150 local pressure gages, 130 local thermometers, and 290 thermowells are installed over and above the instruments normally furnished by manufacturers with the various major pieces of generating station equipment.

In view of the quantities involved, very comprehensive records are maintained, including equipment identification lists and drawings, of all system components. The lists — based upon carefully planned symbols — identify the type of equipment, kind of measurement, and type of measuring device. The drawings show the exact locations of measuring and control points on each piece of equipment, as well as details of: the piping and connection; the primary measuring devices; the measurement transmission devices; the indicating, recording, or controlling devices; and the interconnections between related components. These complete but concise data greatly simplify maintenance procedures, facilitate the purchase of equipment, and prevent duplication.

Developing Identification Symbols

When organizing record systems of this type, a simple language must be developed so lists can be

TABLE 1 — IDENTIFICATION SYMBOLS FOR STEAM POWER PLANT INSTRUMENTS AND CONTROLS

	Equipment		*Kind of Measurement*		*Type of Device*
A	Air heater	A	——	A	Alarm
B	Boiler (includes furnace)	B	Expansion	B	Actuator or positioner
BF	Boiler feed pump	C	Chemical	C	Controller
BD	Boiler drum	D	Draft	D	——
C	Condenser	E	Eccentricity	E	Electric
CH	Chemical	F	Flow	F	——
CP	Condensate pump (other than BF)	G	Relay	G	Relay
D	Deaerator	H	Speed	H	——
DC	Direct contact heater	I	Ignition	I	Indicator
E	Economizer	J	Load	J	——
EV	Evaporator	K	Spindle position	K	Compensator
EX	Heat exchanger	L	Level	L	——
F	Fan	M	——	M	Multipoint
FO	Fuel oil	N	Power Supply	N	Nozzle
G	Fuel gas	O	Position	O	Orifice
H	Feedwater heater (closed)	P	Pressure	P	Pneumatic
M	Miscellaneous	Q	Plug	Q	——
ML	Mill	R	——	R	Recorder
P	Precipitator	S	Sampling	S	Control selector valve or switch
Q	Quick start	T	Temperature	T	Trip
R	Reheater	U	Density	U	——
S	Superheater	V	Vibration	V	Venturi
T	Turbine-generator unit	W	Test well	W	——
		X	Nipple & valve test connection	X	Transmitter
		Y	——	Y	Cut-in or starter
		Z	Humidity	Z	Integrator

prepared, and the information can be transferred to drawing form. Designations essentially are based upon "Outlines of Identification Symbols," shown on pages 5 and 6 of RP5.1 *Tentative Recommended Practice on Instrumentation Flow Plan Symbols,* issued by the Instrument Society of America, May 12, 1949. However, due to the complicated processes involved and the quantities of individual measurements, we have modified this particular system to fit our specific requirements.

Breakdown by Equipment

We believe consideration of a complete plant or process suggests a breakdown by equipment rather than by type or measurement. This makes it much simpler in analyzing the individual measurements and controls required for operating and testing each specific piece of equipment. To accomplish this, letter identification symbols have been set up to use as a prefix to the measurement designation. This additional letter is known as the equipment symbol. The listings for our plant are shown in the first column of Table 1.

Now each piece of equipment listed may be studied in detail for instrumentation and control. As each measurement requirement is thought of, it can be assigned an identification numeral, which will follow the equipment symbol letter or letters. To illustrate, the numbers assigned to the measurement requirements of our deaerator are as follows:

D1 remote record and indication of water level.

D2 local gage glass indication of water level.

D3 local gage indication of pressure in the deaerator steam space.

D4 local thermometer indication of temperature in the deaerator water space.

D5 remote indication of pressure in the deaerator steam space.

D6 local thermometer indication of temperature in the deaerator steam space.

It next becomes desirable to be able to symbolize the kind of measurement such as level, pressure, temperature, flow, and so forth. For this purpose we prefer the letter symbols shown in the second column of Table 1. In practice, the proper letter from this list is placed in the first position following the measurement numeral. On this basis the deaerator measurement examples cited previously become:

D1-L water level, remote record and indication.

D2-L water level, local gage glass.

D3-P pressure in steam space, local gage.

D4-T temperature in water space, local industrial type thermometer.

D5-P pressure in steam space, remote gage.

D6-T temperature in steam space, local industrial type thermometer.

Having symbolized the kind of measurement the next step logically is to identify the individual piece of equipment in the chain, such as primary element, transmitter, relay, indicator, recorder, controller,

or other device. Also if the intelligence or reading is to be via transmission system we wish to identify it as an electric or pneumatic impulse. Both of these identifications again lend themselves to the use of letter symbols, our designations being as shown in the third column of Table 1.

The type of device letter is placed after the kind of measurement symbol in the composite series, and it is in turn followed by the method of transmission symbol. In addition, we insert a number following an indicator or recorder symbol to signify that two or more similar devices operate from the same source or transmitter but are mounted at two or more different locations. Similarly a number following a multipoint symbol designates the identification number of the recorder or indicator on which the reading or intelligence is shown. With this information added, our deaerator designations are:

D1-LXE water level transmitter, electric.

D1-LRE water level recorder, electric, remote.

D1-LXP water level retransmitter, pneumatic.

D1-LIPM2 water level indicator, pneumatic—in multipoint indicator number "M2", remote.

D1-LIE water level indicator, electric, remote.

D2-LI water level indicator, gage glass, local.

D3-PI pressure indicator, steam space, local gage.

D4-TI temperature indicator, water space, local industrial type thermometer.

D5-PXE pressure transmitter, electric, steam space of the deaerator.

D5-PIE pressure indicator, electric, remote, steam space of the deaerator.

D6-TI temperature indicator, steam space, local industrial type thermometer.

Thus we have developed a symbol system, to serve as a shorthand language or identification for our instrument engineers, that is suitable for use on instrument lists and on equipment drawings as well as piping and wiring diagrams. This identification method has the very important advantage of linking all of the equipment in the chain of each transmission or control system. For example, all component devices of a complete, three-element, boiler feedwater regulating system or a complete combustion control system are identified by a common service equipment code symbol and control identification number.

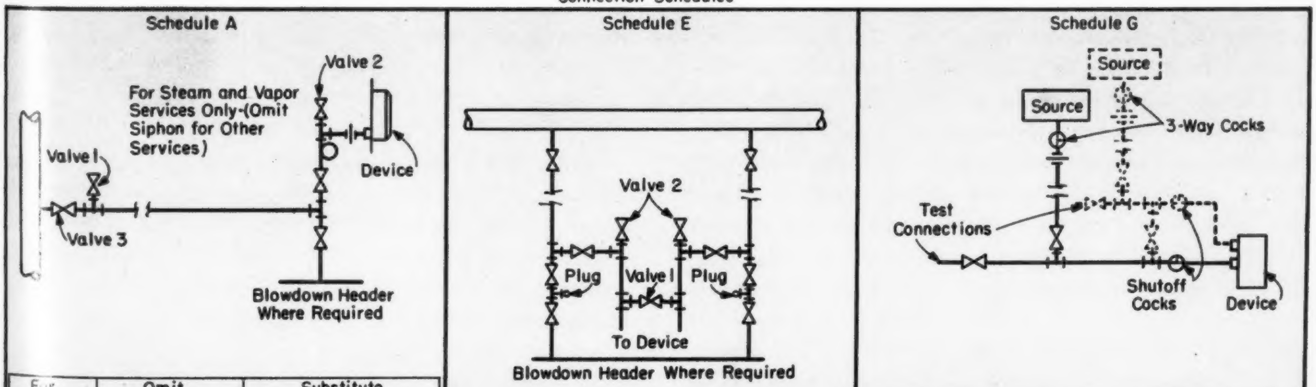
Instrument Connection Schedule

We also have developed another interesting symbol system, known as the instrument connection schedule. With the three sketches shown in Fig. 1 and the use of letter symbols with notations, we can identify some 12 or more variations of the connections required for measuring pressure, flow, level, and draft or differential draft. These schedule symbols are placed in the instrument and control list, and they are used by the instrument engineer when he issues instructions to draftsmen on the proper piping connections between the measurement source and measurement device to show on drawings.

Similarly, we have a measurement source connection schedule. It includes 14 sketches, letter symbols, and notations, and identifies 21 variations of impulse source connections for draft measurements, temperature measurements, flue gas sampling, fly ash sampling, and other services. Again, these symbols are noted in the instruments and controls list by the instrument engineer, as instruction to the draftsman for equipment and piping drawings.

With but minor modifications in assignment of symbol significance, this system can be applied to any production process. Then an instrument engineer has available a shorthand language for transferring information to block diagrams when laying out instrumentation and control. The tabulation also serves as instruction media for draftsmen, purchasing agents, installation and construction forces, and maintenance crews. ▲▲

Connection Schedules



For	Omit	Substitute
Schedule B	Valve 1 and Tee	
Schedule C		Plugs for Valves 1 and 2
Schedule D		Plug for Valve 2
Schedule L	Valves 1, 3, & Tee	

For	Schedule F	Omit Valve 1 (Furnished in Manifold with Device by Vendor)
	Schedule K	Omit Valves 1 and 2

For	Omit	Substitute
Schedule H	3-Way Cock	
Schedule I		Shutoff Cock for 3-Way Cock
Schedule J		Add as Dotted

FIG. 1 — THREE SKETCHES WITH LETTER SYMBOLS AND NOTATIONS IDENTIFY 12 TYPES OF MEASURING CONNECTIONS.

CLEMENT J. FREUND, Dean
College of Engineering
University of Detroit

IF ENGINEERS "PAY LIP SERVICE" TO CODES AT MEETINGS BUT "CUT CORNERS" IN PRACTICE, ETHICAL STANDARDS WILL BE WORTHLESS.

Forget the Lip Service—We Need A Practical Approach to Ethics

WE ENGINEERS always insist that we are hearty men with our feet on the ground. We deal with cast iron, concrete, water, steam, and gas. We shy away from intangibles and abstractions. Yet some of us have begun to think and talk about ethics in the past year or two and wondered: first, do we take our codes of ethics seriously enough; second, do we actually measure and live up to high standards of honor and integrity?

This current interest is just a little surprising because engineering ethics is nothing new. The Founder Societies, the American Institute of Consulting Engineers, and other national societies adopted codes of ethics long ago. In the Thirties, Charles Scott and Dugald Jackson argued and worried about the proposed code of Engineers' Council for Professional Development. William Wickenden and Robert Doherty said and wrote over and over that a real profession is impossible without honor and integrity. Long before that Professor Daniel Mead was giving his famous lectures on ethics at the University of Wisconsin.

Who Is Concerned?

Obviously, not all engineers are genuinely concerned about engineering ethics. The great majority of us don't care about the codes; some of us don't even know about ethics. We have left such matters in the hands of professors and philosophers, and have gone about our business. Indeed, thousands of engineers don't know—and don't care—what it means to be professional.

With most of them, occupational status can be blamed for this indifference. I am thinking about an able engineer, who has been a Chrysler man at least 15 years. He is rightfully a Chrysler enthusiast —the personification of loyalty. Chrysler advertising in newspapers and magazines, and by radio and television, and the superb Chrysler techniques for building morale, have captivated this engineer so completely he has quite forgotten he is a member of a distinguished profession. And there are many more like him at Ford, General Motors, Standard Oil, Allis-Chalmers, Bendix, Du Pont, and other large industrial corporations.

Society Reports

In contrast, there is enough going on to prove that engineering leaders and thinkers are concerned about ethics. The report of the National Society of Professional Engineers for June, 1954, tells about a new board of ethical review in the Society. The Committee on Ethics of Engineers' Council for Professional Development in its annual statement issued September 30, 1954, listed 80 American engineering societies that had endorsed the Council's Canons of Ethics.

Files of the Committee on Ethics of the American Society for Engineering Education contain more than 600 items of correspondence on the question:

are engineers ethical? These letters have come from practicing engineers, officers of engineering societies, engineering educators, editors of general and technical journals, newspaper editors, and presidents and chairmen of engineering corporations.

Less than a year ago, the American Society of Civil Engineers expelled six members for unethical practices. Others have been suspended.

But it is not only the head men who fret about ethics. Ask any engineering dean and he will tell you about young engineers, of the classes of 1950 and since, who bring up these typical problems.

¶ How much credit can my chief draftsman take for ideas I have worked up myself without his help?

¶ A contractor wants to substitute a different concrete mix for the one in the specification. Does he have to talk to the engineer about it if he is sure in his mind that the one mix is as good as the other?

¶ Do I have to keep the trade secrets of the company I used to work for if I have quit and taken a job in another place?

Why Are They Concerned?

This brings up another question: why do thoughtful engineers worry about ethics, as if they didn't have enough else to worry about? They worry about ethics because they are afraid that the engineering profession is in danger of breaking up.

Engineering—indeed, any profession—can flourish only so long as the population has confidence in those who practice that profession. The people have confidence in the practitioner who knows his business of surgery, law, or engineering. But they have still greater confidence in the practitioner when they know that his integrity cannot be challenged. If the ethics of a profession deteriorates, the profession collapses. This is quite clear to many engineers. Others have a "hunch" that it is so.

Still another question logically follows. What does it matter? What difference does it make if the engineering profession collapses? For one thing, engineers will lose their honored position in society. The people still have a high regard for professional men. The professions have always come first in the hierarchy of occupations, followed in turn by commercial and business men, craftsmen and artisans, the semiskilled, and the unskilled. In the American city or town the professional man is a leading citizen. He can be just as important in civic affairs as he chooses to be. He can be important in social affairs if he and his family care for that sort of thing. Engineers will forfeit all this if their profession breaks down. This, of course, is a personal—perhaps a selfish—approach.

Besides, engineering must continue to be professional in order to attract talented young men. While there will always be exceptions, the most gifted students usually aspire to the superior occupations —the professions. As it is, not enough qualified boys enroll in the colleges of engineering. If engineering were to lose its professional standing, the shortage of engineers would no longer be a mere difficulty, it would become a national calamity.

But there is an even more serious matter to think about. If the engineer loses his professional standing, he loses with it his freedom to do his work as he chooses. That, in turn, would hinder his contribution to the well-being of his fellow man. To quote Vannevar Bush, "To minister to the people" is the paramount aim of any profession.

It is the privilege of the professional engineer to be free of unnecessary direction from nonengineer clients and employers. When the officers of a corporation retain an engineer to design and build a bridge—or a turbine, or the controls for a jet airplane—they tell him what to do, but they don't tell him how. They let him complete the task as he thinks best.

If the engineer were not professional, they would give him countless detailed instructions. Since the officers of the corporation presumably would not be engineers themselves, their instructions could be "a comedy of errors." The engineer would be only their hired servant. He would have to do just as they told him, and the bridge, the turbine, or the airplane controls probably would be a badly botched job. By way of comparison, can you imagine a patient telling a surgeon what anesthetic to use, where to make his incision, or how to handle his scalpel?

Unionism and Ethics

Some engineers' sudden interest in ethics and professional status may be caused by concern over the fact that labor unions are infiltrating into engineering occupations. It is difficult to discuss this labor union issue objectively. Whatever your opinions may be, you have to admit that labor unions have won remarkable influence in American industries. They have done a distinct service for the American workingman. But on the other hand, the engineer is not a workingman.

I doubt if the unions have signed up more than a handful of mature and established engineers—men of unquestioned professional standing. Many such engineers are supervisors or owners, and hence not eligible for union membership. They probably wouldn't join anyway. But the Engineers and Scientists of America claimed 40,000 members a year ago, and may have more by this time. The CIO started organizing engineers in the Detroit automobile industries as long ago as last July or August. Engineers are organized in the Sperry Corporation, RCA, Western Electric, Boeing, Minneapolis-Honeywell, Douglas, and elsewhere.

Labor union pressure on engineers is nothing new. Fifteen years ago, for instance, the Federation of Architects, Engineers, Chemists, and Technicians badly frightened employers and professional

engineers. Nothing came of the Federation. Indeed, no engineering labor union has yet accomplished more than an ambitious start. But that is no consolation just now; ESA or CIO might succeed.

Not only mature engineers are disturbed about unions. The chairman of the Department of Mechanical Engineering in the University of Detroit received a letter last Spring from one of his 1953 graduates. This young man wrote, "In the last issue of *Aviation Week* I ran across a report of the strike at the Sperry Company. Those engineers were represented by a union. What is the profession coming to? Don't the engineers of today realize that unionization of professional men means that they are no longer professional?" Such reactions indicate the best of the young engineers don't want to join unions, but many of them have been forced into it against their will.

Professionalism vs Unionism

The concern of engineers about unions is not the familiar employer's disapproval of organized labor. Engineers are worried because they don't see how the principles of unionism can be made to harmonize with the true professional spirit. Many thoughtful and unbiased people still have serious misgivings about labor union organization of clergymen, physicians, lawyers, and professional engineers. The professional man is an individual—an independent performer. It is by no means clear that he properly can be a member of a labor union.

There are, however, other engineers who honestly believe that unions can help them achieve their destiny. This argument was advanced at a session of the American Society of Mechanical Engineers' annual meeting in December. Present at this session was the industrial relations director of a nationally known American corporation whose engineers are organized. He stated that a number of engineers in his company had joined the labor union because they sincerely felt they could improve themselves economically. They are convinced that a better income is a first requisite for attaining full professional standing. Whatever they may have thought about the logic, all who attended the session at least gave those engineers, who had joined unions, credit for being honest in their convictions.

What is the Status of Engineering Ethics?

In view of these numerous variables, what is the actual condition of engineering ethics in the United States? Are we engineers ethical? The great majority of engineers will answer "yes." So will practically all nonengineers who give any thoughtful consideration to the question.

You don't have time or opportunity to read the 600 items of correspondence in the files of the Committee on Ethics of the American Society for Engineering Education. If you did you would discover that newspaper and general magazine editors believe engineers are ethical. Engineer-editors of technical journals agree with them. So do the presidents and chairmen of engineering corporations. In fact, several of the presidents and chairmen went out of their way to commend engineers for their exceptional integrity.

Cause for Alarm

On the other hand, the presidents and secretaries of important national engineering societies are not so sure. A number of them are alarmed. Engineering educators are similarly disturbed. Professor Snell of Michigan State College has repeatedly and emphatically stated his views. The distinguished dean of a famous college of engineering wrote, "Apparently the young graduates go out with a reasonable standard but they soon find out that the consulting engineers and contractors with whom they work are frequently, if not regularly, contributing for political favors. As a result of this, their ideals become converted to the 'practical approach' which leads to dishonest practice." Last Fall, the officials of one of our great American research institutes complained about the lax ethical standards of the young college graduates they have hired in the past three or four years.

The Engineers' Council for Professional Development met at Cincinnati in October, 1954. During the course of this meeting, the Council's Committee on Ethics met in open session. All were welcome who felt like talking about engineering ethics. About twenty men were present, all of them intensely interested in discussing the subject.

One of the twenty told about a consulting engineer, who prepared plans and specifications for a building and supervised its construction. On the side, he collected a handsome commission from the sale of reinforcing steel for this same building. A representative of one of the best known American engineering firms admitted that his firm violates the Canons of ECPD every day. But he insisted that if his firm did comply with the Canons, they would be ruined and out of business in a few months.

Evaluation

It is possible that the 20 engineers in attendance at the session of ECPD came as close as anybody can come to answering the question: are we engineers ethical? These individuals seemed to agree that most engineers "pay lip service" to the engineering codes, but "cut the corners" now and then in the rough and tumble of everyday practice. They felt that engineers hold loyally to the codes in theory, and as a matter of professional pride, but that too many of them cheat a little when they can gain a dollar or two by the cheating. The consulting engineer, probably more than any other, has a special relation to ethical standards.

CONSTRUCTION VIEW OF CANDELA DESIGNED FACTORY AREA WITH THIN SHELL ROOF. PROJECT IS IN MEXICO CITY.

Thin Shell Roofs for Large Buildings

FELIX CANDELA
Cubiertas ALA. S.A.
Architect and Engineer

Felix Candela, graduate of the Escuela Superior de Arquitectura, at the University of Madrid, has been practicing in Mexico City for 15 years, where with his brother, Antonio, he opened an office known as Cubiertas ALA. S.A. The firm has designed more than 70 shell structures, mostly around Mexico City.

Candela is also professor of Building in the Escuela Nacional de Arquitectura, at the University of Mexico.

THIN SHELL ROOFS are nothing new. Certain types of thin shell structures have been known for many years, and they have been used quite extensively in Europe. While methods for the stress investigation of specially shaped shells were developed and basic research on their structural behavior was conducted in Europe (notably in France) more than 20 years ago, it is only in the last few years that the interest of the building trades has been aroused and use of this form of concrete construction has become widely evident.

It is the hyperbolic paraboloid, a ruled surface with two systems of straight generators, that seems to offer the most interesting and economical possibilities for the roofing of large areas. Numerous interesting structures employing these shapes were built in France during the 30's, but apart from some isolated examples in Italy and Czechoslovakia, there has been no general attempt to design such structures in the rest of the world. This is despite their

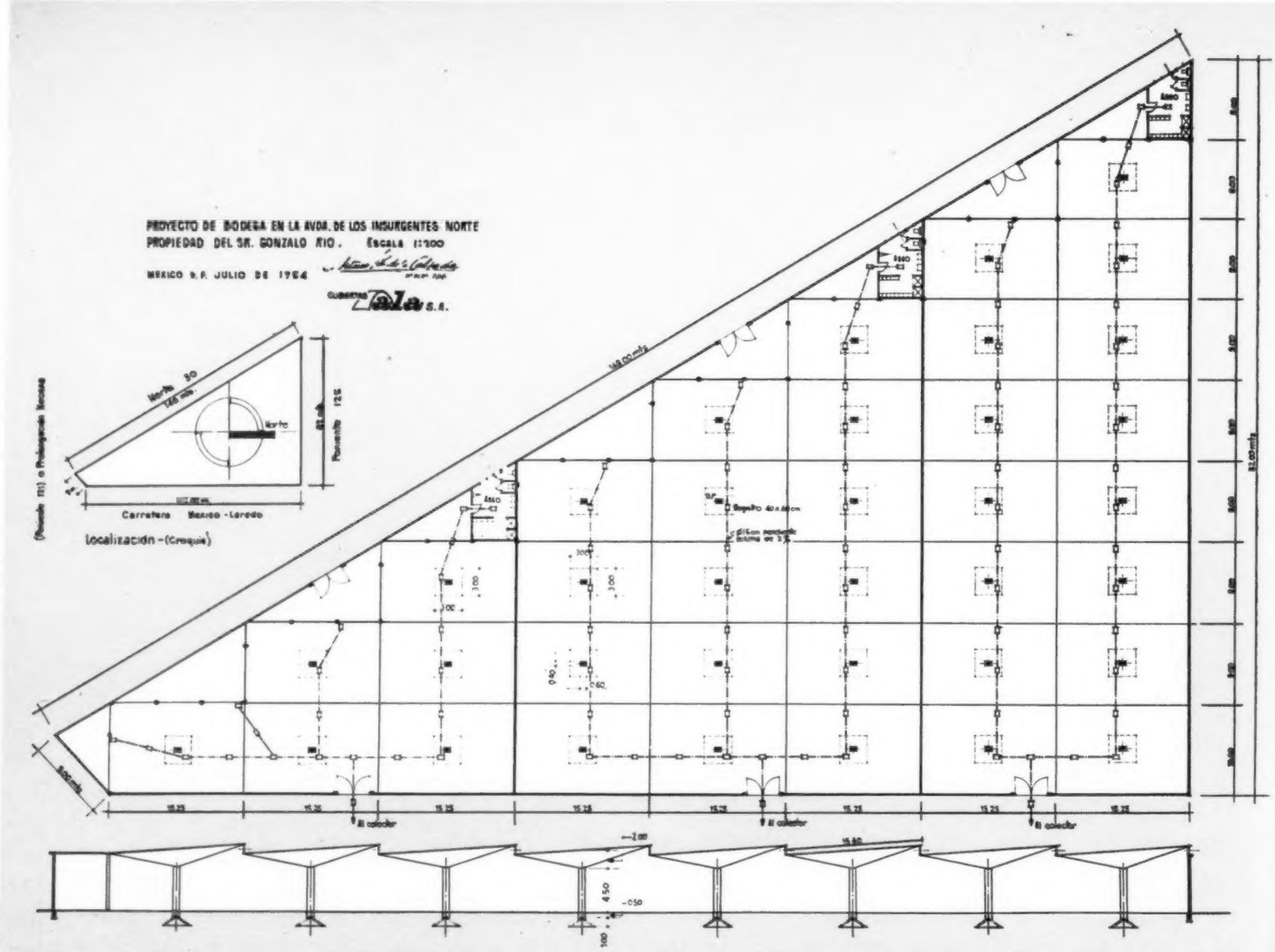


FIG. 1 — THIS ILLUSTRATION IS MADE FROM ONE OF THE DRAWINGS USED BY CANDELA IN DESIGN AND CONSTRUCTION OF THE BUILDING. EACH OF THE RECTANGULAR AREAS IS AN INVERTED UMBRELLA FORMED OF FOUR HYPERBOLIC PARABOLOIDS. THE SMALL TRIANGULAR AREAS ARE COVERED WITH CONVENTIONAL FLAT SLABS AND BEAMS. ALL DIMENSIONS ARE IN THE METRIC SYSTEM. CONVERTED TO ENGLISH UNITS, EACH UMBRELLA IS ABOUT 30 x 50 FT.

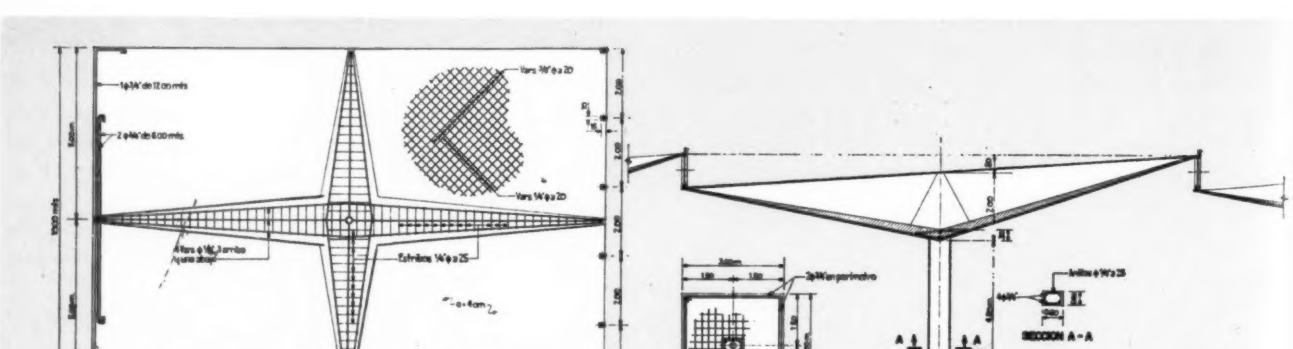


FIG. 2 — AT LEFT IS SHOWN ARRANGEMENT OF REINFORCING STEEL. AT THE CENTER IS A PLAN DRAWING OF THE COLUMN FOOTINGS. AT RIGHT IS AN ELEVATION DRAWING OF A COLUMN AND A ROOF SECTION, SHOWING ROOF TILT.

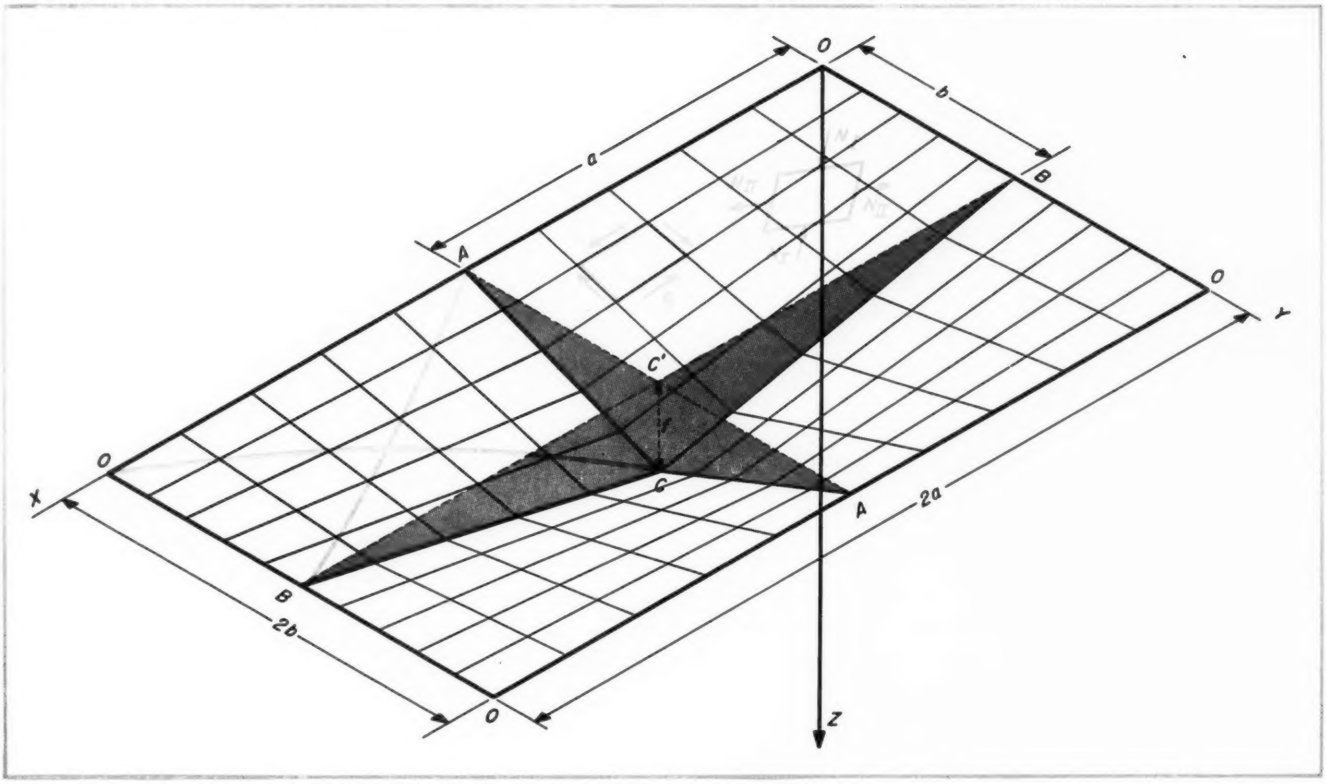


FIG. 3 — TO CONSTRUCT UMBRELLA SECTION GEOMETRICALLY, DROP CENTER C' OF A SIMPLE RECTANGLE A DISTANCE f TO A NEW CENTER C. THEN JOIN SIDES OF THIS WARPED QUADRILATERAL WITH A GRID, AS SHOWN.

obvious advantages and the fact that the fundamental work on stress analysis of these shapes was published in 1936 by the French engineer, F. Aymond[1]. English literature on this theme is extremely scarce. Perhaps the only previous report of first-hand experience is a paper published by me in the *Journal of the American Concrete Institute*[2].

As designer of the Cosmic Ray Laboratory in the University City of Mexico, I had my first experience with the hyperbolic paraboloid although this demanded the covering of but a relatively small area.

The advantage of the hyperbolic paraboloidal shell, as of any other shell structure, lies in the strength derived from form — as opposed to a straight beam or slab, in which strength is dependent on thickness or depth, since they work in bending with a triangular distribution of stresses on the cross section. On the contrary, shells work mainly with membrane stresses evenly distributed on the cross section of the slab or lamina. This results in a more efficient use of the material employed. The roof of the Cosmic Ray Laboratory was built with spans of 33 ft, while the thickness was only 5/8 in.

In 1954, I was awarded the contract for the design and construction of a factory in Mexico City. This project gave me my first opportunity to utilize hyperbolic paraboloidal shells on a large scale. The factory was built on a triangularly shaped lot of about 55,000 sq ft. Bays of 50 ft were required, with a clearance height of 15 ft. The design was also to provide for a small amount of roof lighting from the North. The plan for the building as executed is shown in Fig. 1. It consists of 36 umbrellas, roughly 30 x 50 ft, each being formed by four hyperbolic paraboloidal shells. The remaining triangular areas are covered with conventional flat slabs and beams.

An engineer who has never worked with this shell

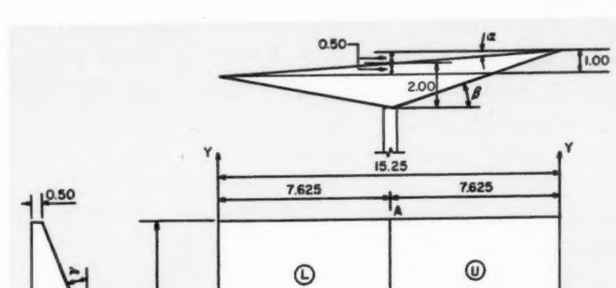
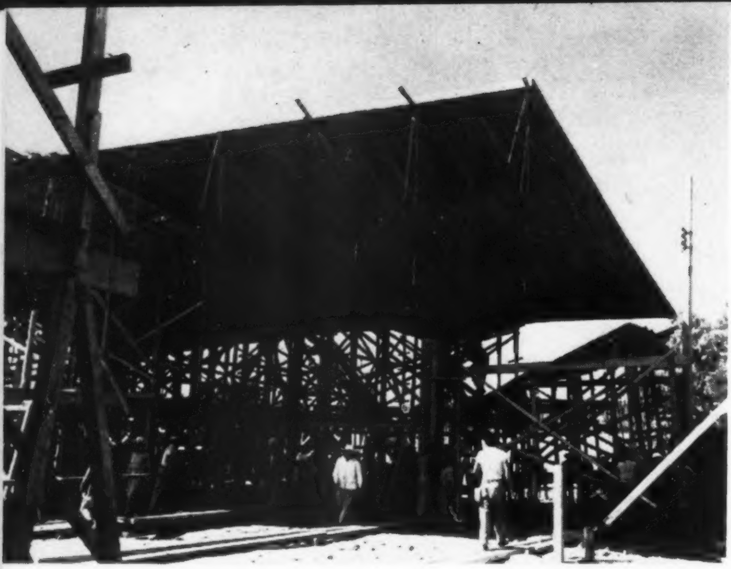


FIG. 4 — DETAIL DRAWING OF UMBRELLA SECTION SHOWING DIMENSIONS AND ANGLES OF TILT USED.

1. Aymond, F., "Etude Statique des Voiles Minces en Paraboloide Hyperbolique Travaillant sans Flexion", *Publications*, Internat. Assn. for Bridge and Structural Engr., 1936.
2. Candela, F., "Structural Applications of Hyperbolic Paraboloidal Shells", *Journal of The Amer. Concrete Institute*, Jan. 1955.



MOVABLE FORMS ARE BEING SHIFTED ON COMPLETION OF ONE UMBRELLA SECTION OF ROOF.

form may best picture the hyperbolic paraboloid if he compares it to a horse saddle. Because of this resemblance, such roofs are frequently called "saddle roofs." An examination of the three-dimensional drawing (Fig. 3) will make clear the saddle shape of each quarter of a roof umbrella.

Geometery of the Shape

The basic shape of each roof element or umbrella is obtained as follows:

Draw a rectangle whose sides have lengths of 2a and 2b (Fig. 3). From the center of this rectangle, C′, drop downward the distance f to a new center, C. Join center C with the midpoints of the four sides of the rectangle, A and B. This forms four warped quadrangles which will be the contour lines for four hyperbolic paraboloids.

The surface of each paraboloid is generated by dividing into an equal number of equal parts the opposite sides of each quadrangle, (five parts in the illustration, Fig. 3) and joining these divisions with straight lines. Each of these lines is now parallel to one of two director planes, ACA or BCB, and these two planes (shaded in Fig. 3) are at right angles. Hence, the paraboloids are equilateral.

Every point on the surface is at the intersection of two straight lines, or generators, contained in the surface. It will be noted that there are two horizontal generators in each paraboloid. These are the exterior lines OA and OB. These intersect at O, the corner of the rectangle, and form the crown of the paraboloid.

If the director dihedral XOY is bisected by a pair of planes, these sections, and all that are produced by planes parallel to them, are parabolic. The curve AB, shown in color, is curved upward at the ends, and the curve OC is downward. These are termed the principal parabolas, and because of their direction of curvature, the surface is called anticlastic or inversely doubly curved.

If the two horizontal generators, OA and OB, are taken along with vertical line z passed through O as the coordinate axis of the hyperbolic paraboloid, the equation for the surface will be:

$$z = kxy$$

where $$k = \frac{f}{ab}$$

Since k is known or can be selected for any design, the coordinate position of any point on the surface can be determined, and forms can be constructed to permit pouring of the concrete to shape.

Stress Analysis

An analysis of stress on a hyperbolic paraboloid can be restricted to an investigation of the membrane state of stresses. Even so, this leads to complex expressions when investigating the effects of arbitrarily distributed loads. However, the basic formulas become extremely simple if the loads are vertical and uniformly distributed in a horizontal projection. Considering this type of load, the expression of the equilibrium along the three coordinate axes leads to the elementary equations:

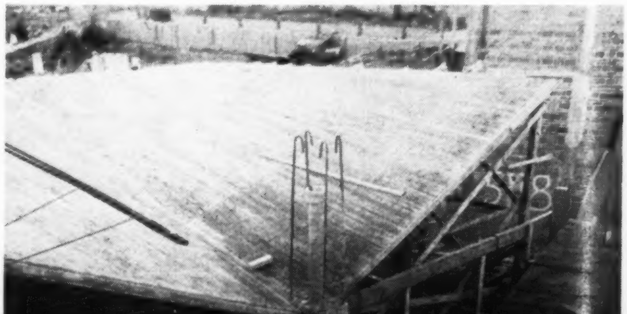
$$N_x = N_y = 0 \quad \text{and} \quad S = -\frac{g}{2k}$$

Symbol S is the unitary shear stress times the thickness of the shell, and g is the vertical load per unit of ground projection. This represents a plane pure-shear state of stress, identical at every point on the surface.

The principal tensile and compressive stresses are directed along the lines bisecting the directions of pure shear; that is, along the principal parabolas. Therefore, in the stress analysis diagram, Fig. 3.

$$N_I \sim -N_{II} \sim S = -\frac{g}{2k}$$

Continuing with the assumption that loads are vertical and uniformly distributed over a horizontal projection, there are no stresses normal to the



THE FORMS ARE PUT IN PLACE AROUND A COLUMN.

THIS CONSTRUCTION PHOTO SHOWS HOW TILT OF UMBRELLAS PROVIDES A SERIES OF SKYLIGHTS.

SINCE THE UMBRELLAS ARE INVERTED, DRAINAGE IS PROVIDED THROUGH CENTER OF EACH COLUMN.

boundary generators (the outer edges of the basic rectangle) that are in directions of pure shear. Non-equilibrated shears add up along the four sides of the warped quadrangle, resulting in tangential tensile or compressive forces depending on the manner in which the surface is supported. These are the only reactions of the shell. The shell transforms vertical loads into tangential forces directed along the four straight edges of the roof element.

On this project the umbrellas were tilted as shown in Fig. 4. This tilting does not change the value of k. Substituting actual values from Fig. 4 (these figures are in the metric system and only to slide rule accuracy) we find that the upper and lower paraboloid give the same value for k despite the tilt.

REINFORCING STEEL IS PUT IN PLACE OVER FORMS.

Then, to find the contour of the roof, we need only substitute in the equation:

$$z = 0.0525\,xy$$

The vertical load per square meter of ground projection g is:

Dead load (reinforced concrete 4 cm thick)	$= 100$ kg/m²
Live load and waterproofing	$= 100$ kg/m²
Total load $= g$	$= 200$ kg/m² (41 lb/ft²)

Since the slope of the surface is small, the load is assumed to be evenly distributed with reference to ground projection. The difference in the value of the stresses determined by this simplification differ only 5 percent from computation by accurate consideration of the real loads.

$$N_I = -N_{II} = S = -\frac{g}{2k} = -\frac{200}{0.105}$$
$$= -1904 \text{ kg/m} \quad (1280 \text{ lbs/ft})$$

Compressive or tensile stresses in the concrete then become:

$$f = \frac{1904}{4 \times 100} = 4.76 \text{ kg/cm}^2 \quad (68 \text{ psi})$$

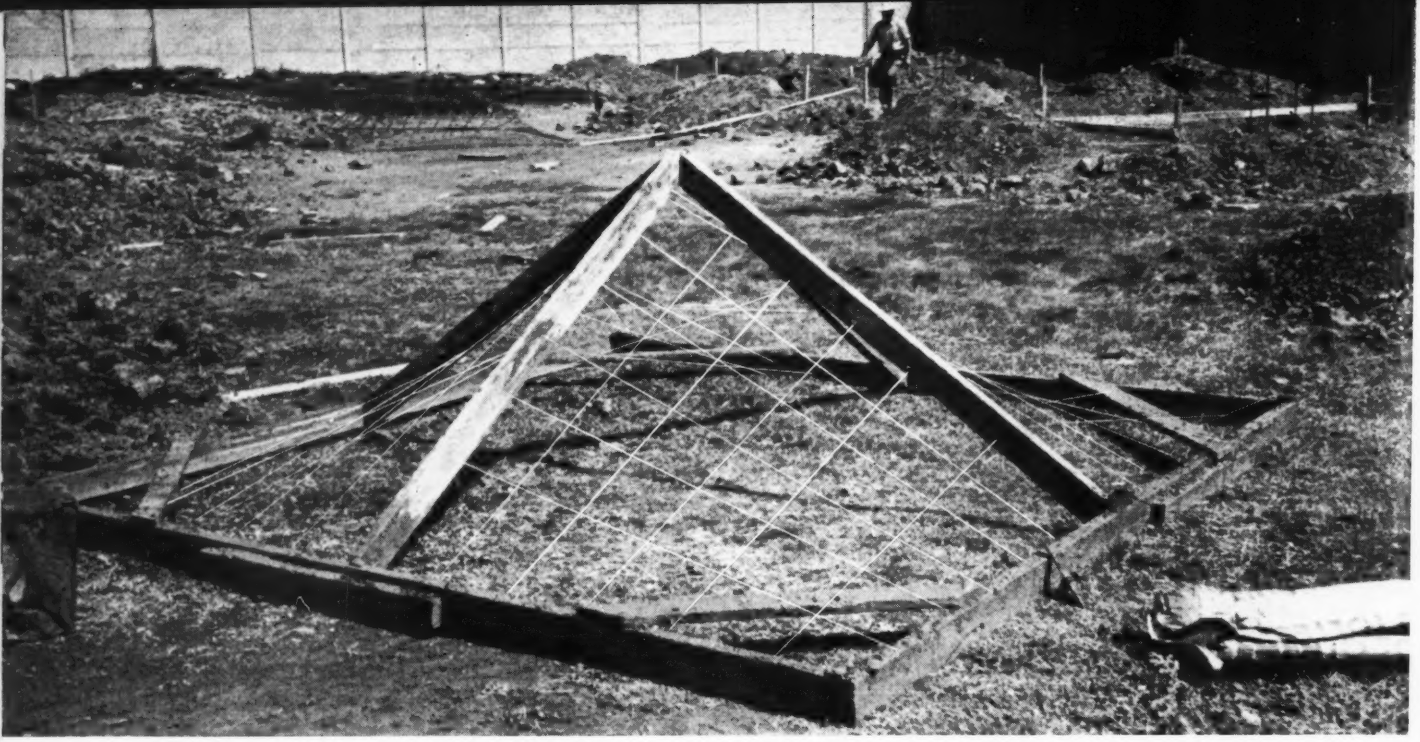
Neglecting the tensile strength of the concrete the necessary diagonal tensile reinforcement required is:

$$A_S = \frac{1904}{1200} = 1.59 \text{ cm}^2/\text{m} \quad (0.075 \text{ sq in/ft})$$

Bars of ¼ in. diameter on 8 in. centers are sufficient according to this calculation, but bars of ⅜ in. at the same separation were provided as an additional precaution against cracking.

Tensile forces along the outer edges increase from zero at corners o to maximums at the central points A and B (see Fig. 4):

$$T_A = \frac{S\,a}{\cos\alpha} = \frac{1904 \times 7.625}{0.9979} = 14{,}700 \text{ kgs} \quad (32{,}400 \text{ lbs})$$



THIS LIGHT, WOOD AND WIRE PATTERN WAS BUILT AS A GUIDE FOR FORMING THE COLUMN FOOTINGS. IT SHOWS HOW A HYPERBOLIC PARABOLOID IS CONSTRUCTED. ROOF UMBRELLAS ARE SAME SHAPE BUT INVERTED.

$T_B = S\,b = 1904 \times 5 = 9520$ kgs (21,000 lbs)

Therefore points A and B require a maximum tensile reinforcement:

$$A_{SA} = \frac{14{,}700}{1200} = 12.25 \text{ cm}^2 \text{ (1.90 sq in.)},$$

or 5 bars of ¾ in. diameter

$$A_{SB} = \frac{9520}{1200} = 7.94 \text{ cm}^2 \text{ (1.23 sq in.)},$$

or 3 bars of ¾ in. diameter

Compressive forces along the inner edges increase from zero value at A and B to maximums at C:

$$C_{CAU} = \frac{2 \times 1904 \times 7.625}{\cos \beta} = \frac{29{,}260}{0.9502} = 30{,}800 \text{ kgs (68,000 lbs)}$$

$$C_{CB} = \frac{2 \times 1904 \times 5}{\cos \gamma} = \frac{19040}{0.9285} = 20{,}500 \text{ kgs (45,000 lbs)}$$

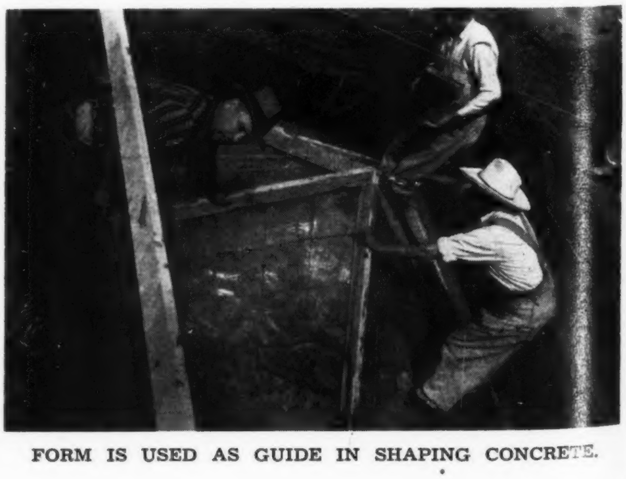
This requires an increase in the thickness of the slab at the inner arists, forming compressive members able to take care of these resultant forces. (Fig. 2)

Supporting Columns

The central column supporting each roof element is considered as built-in at the level of the floor slab and is designed to take care of a horizontal seismic force of 2.5 percent of the weight of the umbrella slab. The value of the horizontal resultant of usual wind loads is lower than the considered seismic forces. Effect of wind in the umbrella slab would only be suction and was not considered in the design of the roof.

The very low bearing capacity of the foundation soil, at Mexico City, requires the disposition of very ample footings. To procure an economical solution,

COLUMN FOOTINGS ARE DUG ROUGHLY TO SHAPE.



FORM IS USED AS GUIDE IN SHAPING CONCRETE.

shell footings of the same form as the upper umbrellas were employed.

Dimensions of one of these footings are (Fig. 2):

$2a = 2b = 3$ m (10 ft)

$f = 1$ m (3.3 ft)

Thickness of slab = 15 cm (6 in.)

$$k = \frac{f}{ab} = \frac{1}{1.50 \times 1.50} = 0.445$$

Design load on each column is:

$P = 10 \times 15.25 \times 200 = 30{,}500$ kgs (67,500 lbs)

Soil reaction (without considering weight of column and foundation slab) is:

$$p = \frac{30500}{3 \times 3} = 3390 \text{ kg/m}^2 \quad (694 \text{ lb/ft}^2)$$

Unitary stresses times the shell thickness are:

$$N_I = -N_{II} = S = -\frac{p}{2k} = -\frac{3390}{0.89}$$
$$= -3800 \text{ kg/m } (2570 \text{ lbs/ft})$$

Compressive or tensile stresses in concrete:

$$f_c = \frac{3800}{15 \times 100} = 2.54 \text{ kg/cm}^2 \quad (36 \text{ lb/in.}^2)$$

This load can be taken easily by concrete alone without steel reinforcement. A mesh of ⅜ in. diameter bars on 8 in. centers was actually used.

Tensile forces at exterior edges have a maximum value at the central point of each side of:

$T = 3800 \times 1.50 = 5700$ kgs (12,500 lbs)

This requires a steel area of:

$$A_s = \frac{5700}{1200} = 4.75 \text{ cm}^2 \quad (0.74 \text{ sq in.})$$

or 2 bars of ¾ in. diameter

Compressive forces at interior edges have a maximum value at the summit of:

$$C = \frac{2 \times 5700}{\cos \tan^{-1} \frac{1}{1.5}} = \frac{11{,}400}{0.8323} = 13{,}700 \text{ kgs } (30{,}000 \text{ lbs})$$

This force can be taken without danger of buckling by the angular members formed by the intersection of both contiguous surfaces.

Since the four hyperbolic paraboloidal sections of each roof umbrella slope toward the center, drainage must be taken care of through the central supporting columns. Asbestos drain pipes 6 in. in diameter were placed in the center of each of these columns.

STEEL IS SHAPED AND PUT IN PLACE FOR POURING.

Construction

The actual construction process is clearly shown in the series of photographs taken as the building progressed. Casting the footings and columns was simple. The ground, a very soft clay, was roughly cut to approximate the desired form. Then a simple pattern, built of 2 x 4 lumber and heavy string was built and lowered into place over the rough clay mound. This acted as a guide to the workmen in coating the mound of earth with cement mortar. This provided a hard surface that helped in performing later reinforcing and concrete work.

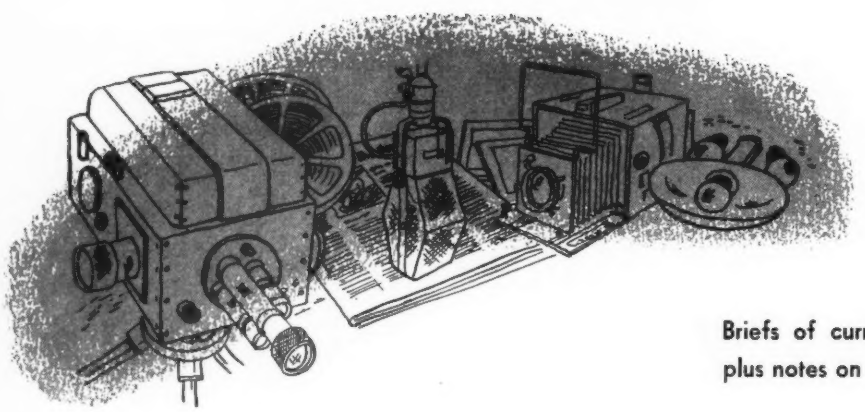
Another of these mortar coated forms was then made on level ground. This was used as a pattern for forming the reinforcing. Each footing was then covered with one of these reinforcing grids, and uprights were welded on as reinforcement for the columns. Columns and footings were then cast in the usual manner.

Forming the roof umbrellas was simpler than would be thought. The forms were constructed in four separate parts, or tympans, for each umbrella. The shape was generated by using straight joists along one system of generators and straight ¾ by 4 in. planks along the second system. These forms were moved separately from one pouring position to the next. The proper height along the outer edge of each form was established, and then the center was lowered to the designated position by means of four small hand winches, one on each of the four tympans making up the umbrella form. When all four tympans were in place and properly centered, reinforcing steel was put in place and high early strength cement poured. A pour per week was possible, and with four sets of forms, the total time required to build the 36 umbrella units, including columns and footings, came to three months.

Ordinary 2000-psi concrete was used throughout, and it was vibrated even in the roof slabs. The absence of any cracks made waterproofing unnecessary.

Costs

The total cost of the structure, including columns and footings, was under 50 cents per square foot of ground projection. This is about half the cost, in Mexico City, of a conventional steel structure of similar spans, roofed with corrugated asbestos or aluminum sheets. Since labor costs are so different in Mexico, it is difficult to estimate the cost of such a building in the United States. However, this could be easily computed by any engineer by applying his local prices for materials and by calculating labor cost at his regional rate. There is no question in my mind but that this is a most economical way to cover large areas with concrete. ▲▲



NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

Underwriters Approves Dry Chemical Piped System

After tests extending over a five year period, Underwriters Laboratories, Inc. has officially approved dry chemical piped fire extinguishing systems as designed by Ansul Chemical Co. With this system, automatic fire protection is provided against Class B and Class C fire hazards by means of dry chemical, which is conveyed through pipes and expelled in the area surrounding the hazard.

Ansul piped systems have already been installed in the metal fabricating, aviation, petroleum, chemical, paper, and automative industries and in the electrical utility field. They provide for either automatic or manual operation and can be activated at the system or from a remote control installation. Automatic systems may also be operated manually.

The automatic systems are operated either by pneumatic rate-of-rise type of heat detection devices or by electrically operated releases. Doors, windows, ventilation ducts, operating valves, and similar equipment can be closed automatically by the system's nitrogen pressure. An electric switch, energized when the system is activated, turns off fans and machinery and sounds alarms around the plant or in a central fire alarm headquarters.

By using automatic selector valves, one piped system can protect two or more separate hazards. Dry chemical flows only into the piping that leads to the fire area involved.

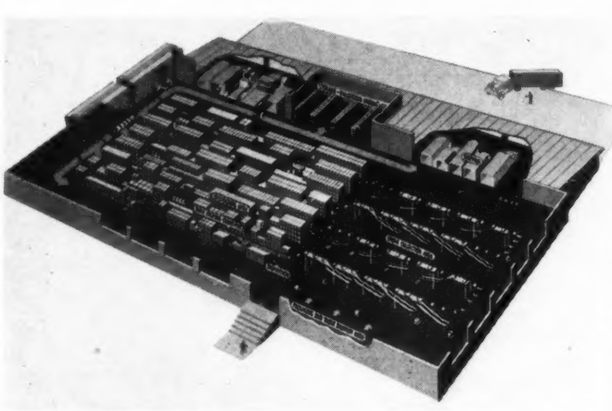
The piped systems may be designed for either local application or total flooding. Each type of system is engineered by Ansul's Special Hazards Section to meet the customer's specific requirements.

Automation Systems for Warehouses Reduce Labor Cost and Space Needed

In the face of expanding markets and greater model and style deversification, today's warehouseman must make better use of personnel and improve handling methods if he is to operate within reasonable percent-of-sales cost. Handling of materials by fork lift trucks and palletizing have helped but basic warehousing procedures have remained unchanged.

Two automated systems—one utilizing an electronically automated conveying system and the other operated by electrical-mechanical controls—have been designed to reduce labor cost and speed handling of materials.

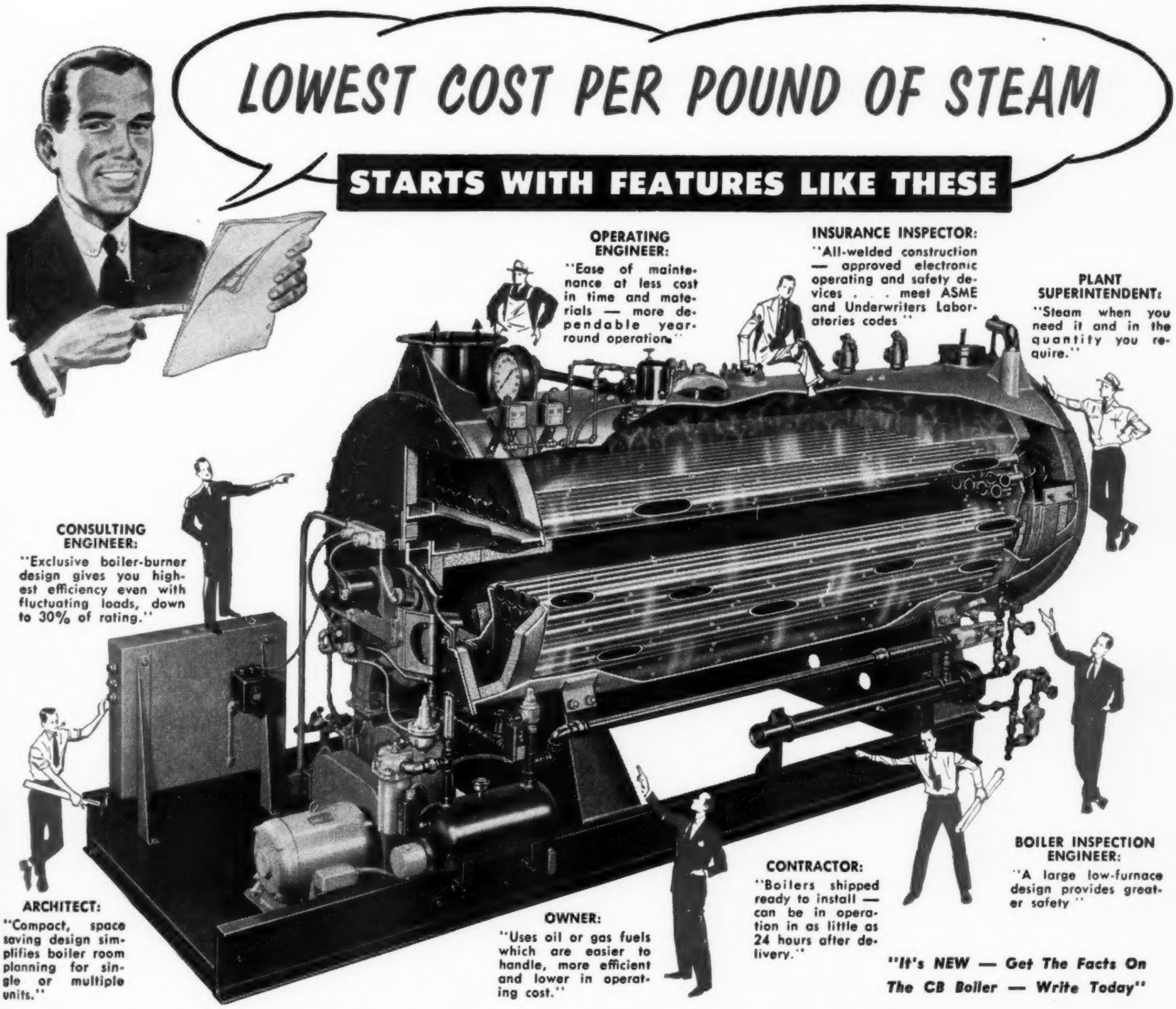
The first, the Kidde Warehousing System, provides advantages of bulk picking while retaining desirable features of conventional order picking. In the Kidde System, incoming orders are broken down by items requested on punch cards which also contain customer's name, address, and other pertinent data. Cards are arranged according to stock sequence and given to the picker who covers a specified number of stations. Items handled in less than case lots are stored in gravity feed storage shelves, six to seven feet high on the picking aisle side, so that pickers can easily reach the top shelf. Above the shelves are racks for palletized storage of additional stock to supply the gravity shelves.



THE KIDDE WAREHOUSING SYSTEM COMBINES ADVANTAGES OF BULK AND ORDER PICKING.

The picker places the items called for and the punched card on a carrier tray attached to a moving conveyor. The conveyor takes the carrier trays past the dispatch booth where a dispatcher removes the card and inserts it in a device called a "card reader." This device activates the conveyor controls so that the tray discharges its load at a predetermined chute serving a particular customer, truck, or route. These discharge chutes are designed to act as temporary storage until the roving packing and shipping crew loads the trucks.

A typical Kidde warehouse section consists of 8-ft wide storage areas with alternate picking and stocking aisles. Incoming merchandise is handled by fork



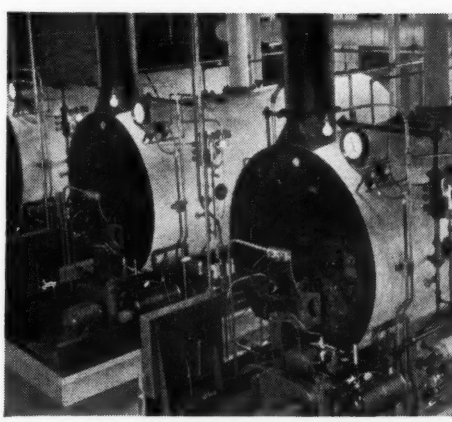
that's why you profit most from Cleaver-Brooks self-contained boilers

• Top to bottom, inside and out, you get more money-saving features when you specify or buy Cleaver-Brooks self-contained boilers. You make an *investment in quality* that pays off in lowest net cost per pound of steam for processing or heating.

YOU BENEFIT from more than 20 years of experience, working closely with men who have made it their business to be *right* about boilers. You profit from complete coordination throughout planning, installing, supervising and final operation.

YOU BENEFIT from self-contained design and original four-pass construction. These Cleaver-Brooks engineered "firsts," plus forced draft, 5 sq. ft. of heating surface per boiler hp, and exclusive burners, all contribute to highest heat transfer. Guaranteed 80% thermal efficiency when firing with oil is the direct result!

Whether you're planning a new steam plant or modernizing, make certain you get the complete Cleaver-Brooks story before you buy. See your Cleaver-Brooks representative, or write for catalog AD-137. Cleaver-Brooks Company, Dept. F, 321 East Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. *Cable Address CLEBRO — Milwaukee — All Codes.*



One typical owner can count on yearly savings ($15,000 fuel and $10,000 labor) from this battery of three 150 hp Cleaver-Brooks self-contained boilers.

Cleaver Brooks
ORIGINATORS OF THE SELF-CONTAINED BOILER

•
NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.
•

BOILERS . . . STEAM OR HOT WATER . . . FOR HEATING OR PROCESSING, IN SIZES FROM 15 TO 500 hp, 15 to 250 PSI.

Automation Systems Cut Cost

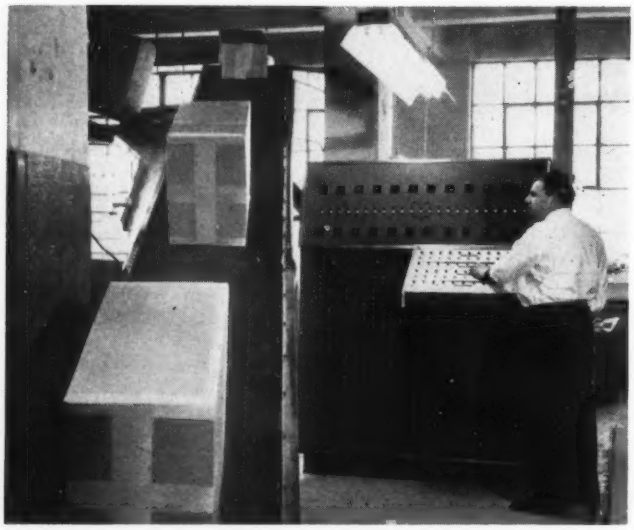
—*Starts on page 60*

trucks, tractor-towed trains, or Trukveyors—palletized or unpalletized. Bulk or cased merchandise is floor-stacked or rack-stacked on pallets. On the stocking side stacks can be 16 ft high or more. Roving stockmen work the stocking aisles to maintain the gravity shelves and picking stacks. Since pickers always remove stock from the front of shelves or stacks, this system assures first-in first-out movement of inventory.

Design of the key equipment components were developed in cooperation with the Link-Belt Co. and the automatic control systems with The Teleregister Corp. A prototype model of the equipment and controls for one class of warehouse application has been built and tested at the Colmar, Pa., plant of the Link-Belt Co. Walter Kidde Constructors, Inc., designers of the system, estimate that it will reduce labor cost by 50 percent and warehouse space up to 25 percent.

The electrical-mechanical control system was designed by Dasol Corp., consulting engineers, for the Manhattan Warehouse of Judy Bond, Inc. Time studies by Dasol showed that 75 percent or more of warehouse employees' time was spent positioning bulk cartons with lift trucks and moving around picking out orders. It was also determined that all customers' size requirements could be broken down into basic half dozen assortments, with any one color of any style packed to a carton.

The heart of this system is DASAC, a push button



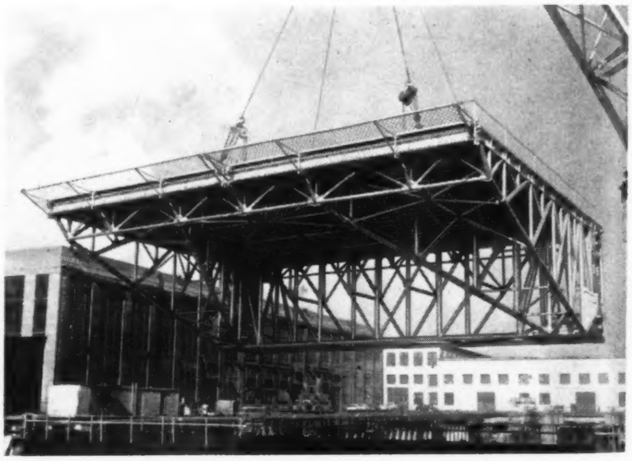
FLASHING LIGHTS AND COUNTERS ON DASAC PANEL REPORT LOCATION OF CARTONS, TELL WHEN MORE CARTONS ARE NEEDED IN RACK.

console located in the receiving area of the warehouse and operated by the same warehouseman who places the original factory shipping containers on a conveyor belt. On the DASAC console are 23 push buttons, one for each order filling rack. As the handler places the bulk container of blouses on the conveyor, he pushes the appropriate button to indicate to which rack the container is destined. When the bulk container reaches the proper rack for style and color desired, the conveyor automatically stops and the container is mechanically pushed off, down the rack, to where the order filler stands. As the container is turned on its side by a tilt mechanism, the DASAC console board records reduction of one container in inventory for the rack.

This installation has reduced direct labor required for warehousing and order filling by 66 percent, reduced necessary floor space by 66 percent, and increased capacity of shipping department 100 percent.

All-Aluminum, Welded Elevator Designed for Shangri-La

Because weight is an important factor on carrier ships, the deck-edge elevator for the Navy's new carrier, the Shangri-La, has been made of aluminum with a saving in weight of 17 tons as compared to steel. This 87,000 lb elevator will transport planes



DECK-EDGE ELEVATOR FOR THE SHANGRI-LA IS THE LARGEST KNOWN ALL-ALUMINUM WELDED STRUCTURE.

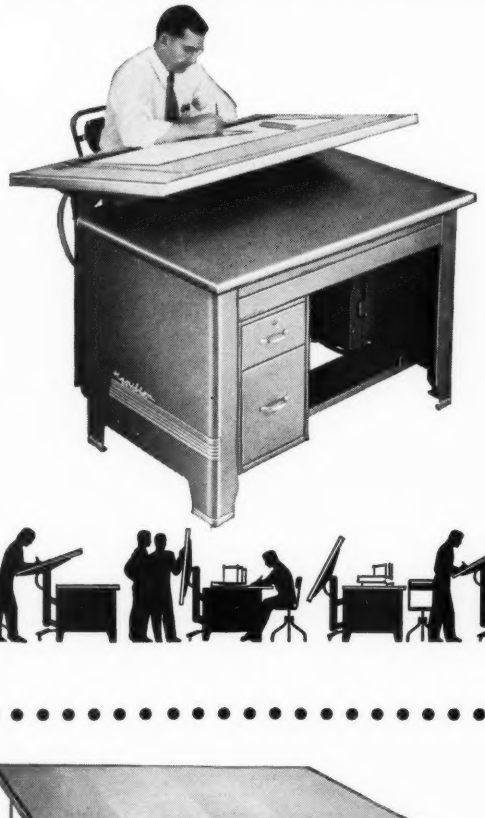
between the flight deck on top of the carrier and the hanger deck below. To be installed on the port side, it will act as a continuation of the vessel's canted deck when in raised position.

Structural members are of aluminum tubing supplied by Reynolds Metals Co. and welded together by the inert-gas metal-arc welding process. To assemble the elevator, subassemblies were constructed as large as possible at the Puget Sound Naval Shipyard. Tests were then made to determine proper welding sequence for best heat control throughout the structure. As many as nine pieces of tubing are welded together at a single point. These clusters are reinforced by splice plates designed and positioned to distribute working loads lengthwise for a portion of each tube. This distribution of forces greatly increases loading factors and overall efficiency.

The elevator, as designed by naval architect Jack Thompson, is essentially a cantilever structure composed of a series of transverse and logitudinal trusses covered with longitudinal I-beams and a thin skin of

Why Put Up With These Problems in Your Drafting Room?

Your Bruning Man Can Help You Solve Them With Hamilton Auto-Shift Tables



Let your Bruning Man show you how the unique design of Hamilton Auto-Shift Tables not only can help you solve present problems but also allow for orderly, integrated expansion.

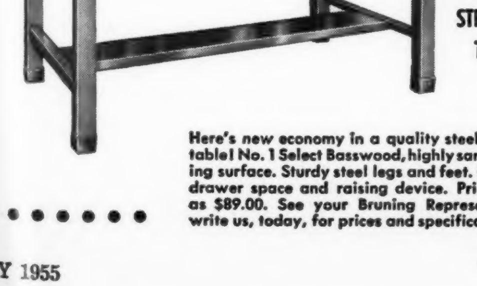
How Auto-Shift increases space and operating efficiency

Auto-Shift combines a board and reference desk in one unit to make more effective use of space. When used in row installation, as pictured at the left, Auto-Shift puts a large reference surface and drawer directly behind each draftsman for even greater space and operating efficiency. To check reference material, the draftsman need only turn in his chair and slide the reference surface toward him. Over conventional desk-next-to-board arrangements, this Auto-Shift feature saves time and floor space.

How Auto-Shift reduces draftsman fatigue

Auto-Shift provides convenient foot and hand releases for instant, effortless one-man adjustment of height and slope. Counterbalanced top allows finger-tip control of slope. Draftsman can change position often and yet reach any part of the board without strain whether seated or standing. He works faster and easier; production rate goes up!

See for yourself how the advantages of Auto-Shift can increase space and operating efficiency in your drafting room. Mail the coupon below for detailed information.



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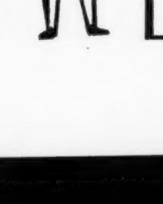

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Please send me information on Hamilton Auto-Shift Tables.

Name________________ Title________________

Company________________________________

Address________________________________

City____________ Zone______ State________

Aluminum Elevator for Carrier

—Starts on page 62

aluminum. It is surfaced with wood to form the flight deck. Two sets of rollers run in vertical tracks to provide the movement required. This is the first of 12 or more such elevators planned for Navy carriers.

Mirror, Mirror on the Wall Who's the 'Most Sought After' . . .?

A record 200 companies sent representatives to interview the 95 members of the January graduating class of engineers at Illinois Institute of Technology. And the men who were hired started at an average of $383 per month—another record figure. Earl C. Kubicek, IIT director of alumni relations and placement, attributed these figures to the nation's shortage of technically-trained personnel.

At the University of Florida's College of Engineering, the Mechanical Engineering Dept. has become aware of a change in the attitude of the student with reference to the interviewing procedure. Students are increasingly reluctant to be scheduled for interviews and are seeking more advice regarding policy, advancement, future trends, and fringe bene-

fits of the organizations that interest them.

Department head John C. Reed and professor E. H. Lewis conducted a survey in several classes asking why so few students were requesting interview time. Typical answers were:

"I've already accepted a job;"

"I hate to spend an hour doing a good job on an application blank before I know whether or not the particular opportunity is the one that interests me;"

"So far, I have a total of eight offers, hence I interview only those I believe have something special to offer me;"

"I only want to work in two parts of the country (Mass. and Calif.), and only interview the companies from these two sections;"

"If the company has operations in Florida or the Southwest, have them advance the information. In particular those companies who list their address as Chicago, New York, etc;"

"Representatives of most companies can't give any definite information about job possibilities. All that most of them do is give you company propaganda, their pamphlets, and act as messengers to carry your application to the home office. For a 3c stamp you can save hours of time."

In addition to the above information, a survey was made to determine the job status of the June graduating class. Of eighteen scheduled to receive their degree in June, twelve have already committed themselves and two plan to take graduate work. This leaves only four M.E. students available for scheduling interviews with commencement three months in the future (survey was made in April). Three students made commitments as early as November.

The surveys also showed an increasing interest taken in students by consulting firms.

Short Summer Courses Offered for Engineers

Date	Course	Place
June 13-17	Industrial Standardization Conferences	Engineering Societies Bldg. New York, N.Y.

For more information contact Dr. John Gaillard, 400 West 118th St., New York 27, N.Y.

•

Date	Course	Place
June 13-17	Three-Dimensional Planning Technical Workshop	Pittsburgh, Pa.

Contact Plant Layout Technical Workshop, P.O. Box 225, Oakmont, Pa.

•

Date	Course	Place
July 5-15	Soil Engineering for Airfields and Highways	MIT Cambridge, Mass.
July 11-22	Behavior of Materials at Elevated Temperatures	MIT
Aug. 15-26	Noise Reduction	MIT
Aug. 22-Sept. 2	Numerical Control of Machine Tools	MIT

For information on any of these four courses, contact Summer Session Office, Room 7-103, Massachusetts Institute of Technology,, Cambridge 39, Mass.

▲▲

the Range Finder

DR. GERALD J. MATCHETT
Department of Business and Economics
Director, National Center of Dynamic Equipment Policy
Illinois Institute of Technology

. . . games and business strategy

A NEW FIELD worth watching is game theory.

Attention was recently drawn to the theory of games by President Eisenhower's appointment of John von Neumann to a post with the Atomic Energy Commission. Von Neumann, a distinguished mathematician, originated the concept of game theory. He was the co-author with economist Oskar Morgenstern, of the pioneering book on the subject, *The Theory of Games and Economic Behavior*, published by Princeton University Press, in 1944.

The laws governing games of pure chance are not new, of course. Relatively simple probability theories describe the behavior of dice or a wheel of chance. Games like craps and roulette can be easily understood in terms of these laws. Mathematics cannot tell us how to break the bank at Monte Carlo, but it can furnish us with the odds on our doing so. Modern game theory attacks the far more difficult problems that arise in games of more than one competing player—games in which the success or failure of a player depends on his strategy as well as blind chance—games in which the opposing players' strategy must also be taken into account.

Games and Economic Activity

The connection between such games as chess or poker and economic activity may not be apparent at first glance. A little reflection, however, shows that the term "game" can be applied in a rather precise sense to business. Consider some of the problems that might arise if a concern has only one significant competitor. The firm in question, like the other, would have to make decisions as to volume of output and pricing policy. It would have to expect that the competing firm would react in turn. A price cut, for example, might lead to a price cut by the competitor. Experiences with price wars" bear this out. A chess player must think constantly "If I move here, what will my opponent do?" So, in a good many instances, business management must expect that its policies will evoke responses from its competition.

Of course, there are industries where a very large number of small firms are active. In such cases, each firm may well feel that its actions will have no effect on the others involved. This situation, well typified by farming, is referred to by economists as "perfect competition." Here, we might well expect that the results of game theory would have little applicability. It was the hope of von Nuemann, Morgenstern, and others that insight might be gained into a variety of business decisions by studying situations characterized by an "If I do this, he does that" relationship. Analytical techniques might result that would be useful for the study of how our economy works and would serve those charged with making economic decisions in individual firms.

One further area of application of game theory deserves mention. War may be thought of as a "game," too. A particular offensive action or weapon calls forth a defensive response, and vice versa. It has been reported, for example, that ideas derived from game theory were used during World War II in devising strategy for such realms of combat as anti-submarine warfare.

General Approach

Even the precise definition of a game, for purposes of the theory, is somewhat complicated. Still more complicated is any systematic explanation of the analysis. However, some idea of the scope of the problem as well as its approach can be obtained from a few very simple examples.

The simplest form of game is the so-called zero-sum, two-person game. It is termed zero-sum because in such a game one player loses the amount that the other wins. At the outset of the game, players A and B are each confronted with a set of "action-choices," that is, ways of playing. Each

combination of choices—one of A and one of B—leads to A's winning a certain amount (perhaps negative).

Player A tries to maximize his winnings. Player B simultaneously attempts to minimize the winnings of A. (Here is the genesis of the term "minimax," which so often crops up in the literature.) Roughly speaking, one expects that the outcome of a game played by two skillful players could be represented geometrically by a "saddle-point" — the place on a saddle-shaped surface where the low point on one curve coincides with the high point of another.

In games like tick-tack-toe, the theory tells us that if we know enough about the rules and possible combinations of moves we can predict with certainty the outcome. (As most of us know, the first player in tick-tack-toe is bound to win if he plays well.) Checkers and chess fall also in this pattern, although the number of combinations of moves is so great as to elude efforts to specify the outcome in practice.

In other games (poker is an example of this) the cards are not all on the table. The theory tells us, as we would expect, that part of the play here is to keep one's opponent guessing. It defines concept precisely by assigning probabilities to each action choice.

Where more than two players are involved, an additional feature enters — the possibility of some players combining. In a three-person game, player A might find it advantageous to join with B against C. He might even find it so profitable that he would share his winnings with B to keep the alliance in effect. The game of many players thus becomes, in part, a struggle for allies. Here again, the conclusion would appear to square with business experience. In fact, to maintain competition in many sectors of the economy, the government has been led to enact a series of anti-trust laws designed to prevent certain kinds of "alliances." ▲▲

INDUSTRIES THAT MAKE AMERICA GREAT

PAPER...HOW MANY MARKET BAGS IN 31 MILLION TONS?

That's the amount of paper in its many types that was produced in the U. S. in 1953 for packaging—to say nothing of newsprint and the hundreds of other forms paper takes to make life easier.

All of which is intended to point out that the paper industry is vast and growing to such a degree that vast will soon have a limited meaning. Demand, of course, is one of the reasons for the size of this industry. The desire to make paper better while making more of it, and the financial daring that must be a part of industrial advance, are others.

Still others are the technical contributions from *other industries* that aid in growth and improvement. Take steam, for example. Its generation, to meet specific requirements under complicated situations, is a job that demands long technological strides to keep up with the industries it serves.

Steam is a *basic* in the paper industry and The Babcock & Wilcox Company, from the very beginning, has kept pace with paper through steam generating equipment for power, processing, heating and chemical recovery.

With paper, as with all industry, it is a fast and exciting pace. Just how fast and exciting can best be indicated by developments in the industry that have, in fact, given paper a new dimension.

BABCOCK & WILCOX

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BOILER DIVISION

N-197

MEN IN ENGINEERING

★ Dr. William L. Faith, deputy director and chief engineer of the Air Pollution Foundation, is elected vice-president and chief engineer by the board of trustees.

★ Engineers Joint Council announces election of the American Society of Refrigerating Engineers as a constituent society. The American Institute of Industrial Engineers becomes an associate society, the first organization to become an EJC associate.

★ Engineers' Council for Professional Development has expanded its pilot-study program for young graduate engineers known as the "First Five Years of Professional Development," to the Detroit area.

George A. Porter, vice president of Detroit Edison Co., will serve as chairman of the Detroit Sponsor Group. Edwin L. Yates, director of college and university relations, General Motors Corp., has been appointed chairman of the ECPD Professional Training Committee. The "First Five Years" program has been under test for two years in Cincinnati, Ohio.

★ Luther E. Cliffe, chief of the Foreign Activities Div., Bureau of Reclamation, has resigned to accept a position as assistant resident engineer with the Power Authority of the State of New York.

★ Two assistant physicists have been appointed to the Applied Physics Div. of Midwest Research Institute: Charles W. Mullis and M. A. Wolf. Mullis comes from the engineering and industrial experiment station of the University of Florida, Wolf was with Convair Div. of General Dynamics.

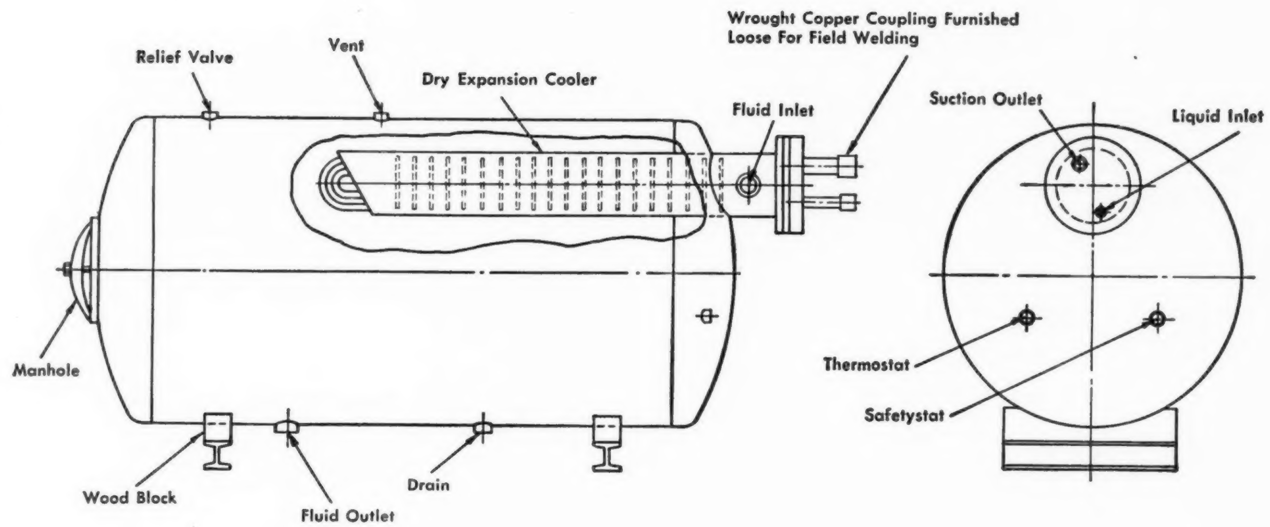
★ Myles C. McGough is elected a vice president of Merritt-Chapman & Scott Corp. He will be in charge of the company's industrial and building construction dept.

★ Mellon-Stuart Co. has elected H. A. Saurbrey to the board of directors. He was formerly executive vice president.

★ Five Carnegie Tech professors in the Department of Chemical Engineering have combined their consulting practices to form Associated Chemical Engineers, a consulting partnership with offices at 5118 Beeler St., Pittsburgh, Pa. The partners are R. B. Beckman, L. N. Canjar, R. R. Rothfus, H. L. Toor, and D. H. Archer. The firm will serve petroleum, chemical, and allied industries.

★ The Associated General Contractors of America have elected George C. Koss, president, and Frank J. Rooney, vice president for one-year terms. Koss is president of the Koss Construction Co., Des Moines, Iowa, and Rooney is president of Frank J. Rooney, Inc., a building construction firm in Miami, Fla.

ASME SPRING MEETING
H. B. Maynard, right, pres. of Methods Engineering Council, spoke on "Extending Management Know-How Abroad" at ASME's spring meeting in Baltimore. L. E. Newman, left, mgr., education and training services, General Electric, presided at the management luncheon.



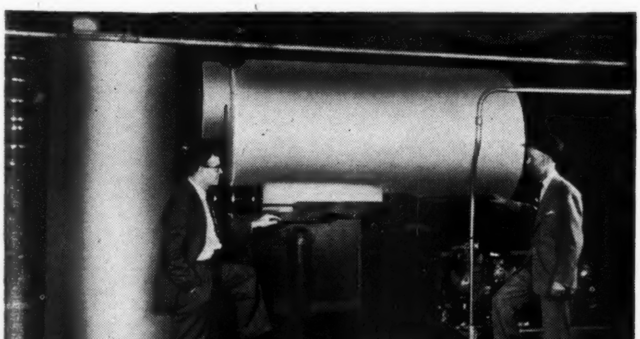
Now in a complete line of standard sizes

p-k Dry Expansion *Storage* Cooler

If your problem involves a fluctuating demand for chilled fluid . . . or storing large quantities against peak needs . . . then you should check these *standard* p-k units . . .

OPERATION IS SIMPLE:

A p-k dry expansion cooler is mounted *inside* a p-k storage tank. Fluid from the system and any necessary makeup passes through the shell side of the cooler located in the upper portion of the tank, drops to the lower portion, and is recirculated through the system.



COST IS LOW:

Using this forced circulation method of cooling, you get a heat transfer rate many times that obtained from natural convection alone. It's the most efficient system available — and that makes your cost of operation the lowest, levels out sudden demands, and reduces the load on your accompanying equipment.

p-k storage coolers can be constructed of steel, galvanized steel, stainless steel, stainless clad steel, solid copper, copper-lined, aluminum, copper silicon, or whatever material your problem requires. They're built in accordance with ASME codes and so stamped if desired. Their rated cooling capacity is guaranteed. And — they've been tested on the job, by leading engineering firms and users. Write for Catalog 1141 containing complete details.

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MEN

—*Starts on page 70*

★ E. Alfred Picardi joins the architectural and engineering firm of Bellman, Gillett & Richards as an associate and chief structural engineer. He was formerly chief structural engineer for Kaighin & Hughes, Inc., Toledo, Ohio.

PICARDI WISELY

★ William H. Wisely has succeeded Col. William N. Carey as executive secretary of the American Society of Civil Engineers. Carey, who held the post for the past 10 years, is retiring as executive secretary-emeritus.

★ Owen S. Lieberg is now associated with Cosentini Associates, of New York City. He will continue to specialize in the design of high temperature water installations and radiant cooling and heating systems.

★ H. K. Ferguson Co. are designers and constructors of a 360,000 sq ft distributing house being built for Western Electric Co. in Queens, N. Y. The building will have a structural steel frame. To be built of reinforced concrete with masonry walls it will be completed in a year.

★ In the Engineering Dept. of the Salt River Power District, C. V. Watters becomes supervising engineer of the Planning and Statistical Div., E. J. Lauerman is named liaison engineer between Bechtel Corp. and the Power District during planning and construction of the new 100,000 kw steam power plant in the Glendale-Peoria area. Freemont L. Roe continues as staff consultant.

★ William Marshall, Jr., architect, is admitted to partnership in the firm of Lublin, McGaughy & Associates, Architects and Consulting Engineers. Marshall has been with the firm for the past four years.

★ Di Stasio & Van Buren, New York consulting engineering firm, which designed the largest known reinforced concrete floating drydock for the U.S. Navy last year, has received the 1955 award of the Concrete Reinforcing Steel Institute for outstanding accomplishment in the field of concrete design and construction.

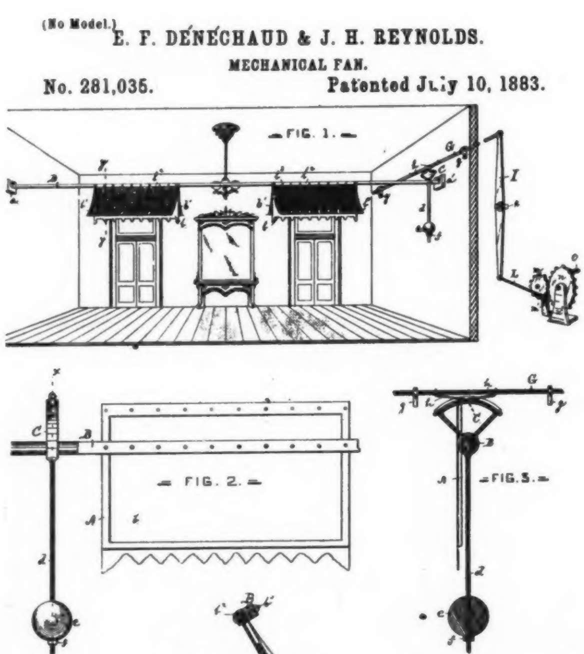
★ Thomas Currie and Kenneth Van Dyck announce formation of the firm of Currie and Van Dyck. Located in Southport, Conn., the firm will offer industrial design service.

GENIUS AT WORK — 1890

THE PACE OF DAILY ACTIVITY was a bit slower in 1883, when E. F. Denechaud and J. H. Reynolds, of New Orleans received letters Patent No. 281,035, for their Mechanical Fan. They acknowledged the possibility of using "any well-known motor" as a drive, but the drawing strongly suggests the most economical servant-drive as more practical.

The fan consists of a rigid leaf (b) with sets of light flys (b') on each side. As the rigid leaf is raised it raises the flys on that side, and as it moves back the flys fall slowly of their own weight. Supposedly, the rigid leaf provides for the air movement, while the flys (streamers) drive away flies (insects). In fact, it is suggested that these flys be made of fly-paper. We question the artistic merit of streamers of fly-paper after several weeks of operation during a New Orleans summer in the 80's, but the inventors are not unaware of artistic requirements. They point out that the rigid leaf could be constructed of canvas on a frame, and this could be painted or embroidered. The remaining portion of the apparatus "may be a permanent fixture of the room, expensively and elaborately ornamented to form a part of the decorations of the room."

Modern air conditioning may be more efficient, but this invention we like. We hope Messrs. Denechaud and Reynolds did well.



From the Patent Collection of Mike Rivise

BOOKLETS

For copies of these booklets for your files, write on company letterhead directly to address given. For immediate service, telegraph and request Air Mail Delivery.

"SYSTEM LOAD AND FREQUENCY CONTROL," 12-page bulletin 9060, tells how servo controllers can provide faster, better control of system load and frequency. A complete system to regulate frequency, schedule, and interchange is described. *Minneapolis-Honeywell Regulator Co., Industrial Div., Dept. CE, Wayne & Windrim Avenues, Philadelphia 44.*

SWITCHGEAR—The plus values offered by GE's metal-clad switchgear are outlined in 52-page publication GEA-5664C. Of special interest are tables of dimensions and weights, foundation data, and guide form specifications for many applications. *General Electric Co., Dept. CE, Schenectady 5, N. Y.*

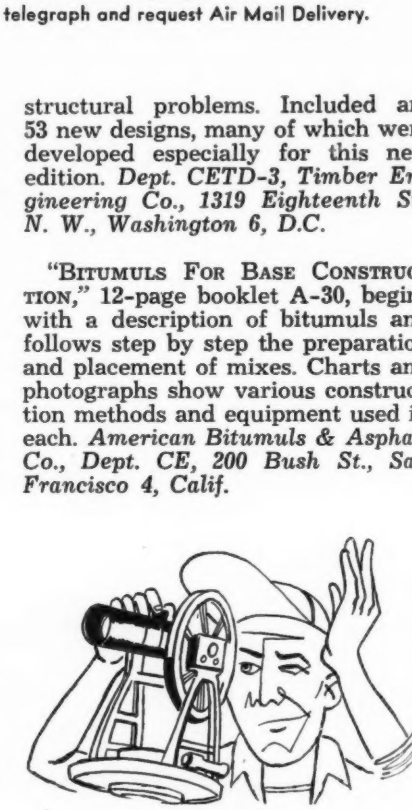
CEILING DIFFUSERS—Job requirements can be determined in the layout stage with use of 28-page catalog F 6597 on the Uni-Flo square, rectangular, and linear ceiling diffusers. Ordering information and installations methods are included. *Barber-Colman Co., Dept. CE 766 Rockford, Ill.*

"MEN, METHODS, & MACHINERY," 40-page brochure, tells how this company has saved substantial sums for clients by original thinking and invention, devising practical solutions to engineering problems. *Construction Aggregates Corp., Dept. CES, 33 N. LaSalle St., Chicago 2, Ill.*

FACT FILE on PTM Post tracing medium contains working samples of the paper with facts on benefits such as film-like transparency, evenly textured surface, and dimensional stability. *Clay Seipp, Dept. CE, Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, Ill.*

"TYPICAL DESIGNS OF TIMBER STRUCTURES," a revision of the 1948 edition, contains 102 typical designs that illustrate suggested methods of Teco timber connecter wood framing for the more commonly encountered structural problems. Included are 53 new designs, many of which were developed especially for this new edition. *Dept. CETD-3, Timber Engineering Co., 1319 Eighteenth St., N. W., Washington 6, D.C.*

"BITUMULS FOR BASE CONSTRUCTION," 12-page booklet A-30, begins with a description of bitumuls and follows step by step the preparation and placement of mixes. Charts and photographs show various construction methods and equipment used in each. *American Bitumuls & Asphalt Co., Dept. CE, 200 Bush St., San Francisco 4, Calif.*



"29 REASONS WHY . . . YOU'LL WANT A WARREN-KNIGHT," 4-page folder F-16937, shows you how this transit can save you time and money. Trial order blank in the booklet will give you an opportunity to test the instrument on your own project for ten days without charge. *Warren-Knight Co., Dept. CE, 136 N. 12th St., Philadelphia 7, Pa.*

"ANALYSES OF STANDARD CARBON, ALLOY, AND STAINLESS TUBING STEELS," four-page technical data card 177, gives information of interest to engineers and designers working with tubing for elevated temperature and pressure service. *Babcock & Wilcox, Dept. CE, Tubular Products Div., Beaver Falls, Pa.*

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BOOKLETS —Starts on page 74

and lintels, and pipe and brick—is illustrated and described in four-page folder 505. *Forney's Inc., Dept. CE, 209 Elm St., New Castle, Pa.*

School Design—Offered as an aid to architects and engineers interested in school design, this brochure consists of pictures and detachable architectural details relating the use of Fenestra panels, sash, and doors in school buildings. *Detroit Steel Products Co., Dept. CE, 2250 E. Grand Blvd., Detroit 11, Mich.*

"Modern Tools for All Ground Resistance Testing," eight-page bulletin 1-2, describes the Vibroground line of portable field instruments for measurement of ground resistance, soil, and earth resistivity. *Associated Research, Inc., Dept. CE, 3758 W. Belmont Ave., Chicago 18.*

Indoor and Outdoor Swimming Pools and equipment for filtering and recirculating are described in 12-page bulletin WC-109. Typical drawings of the systems are accompanied by an explanation of advantages inherent in each type of system. *Graver Water Conditioning Co., Dept. CES, 216 W. 14th St., New York 11, N. Y.*

"Scientific Plant Location," 12-page booklet, tells how this company applies the scientific approach to plant location problems. A partial list of clients is included. *Fantus Factory Locating Service, Dept. CE, 139 N. Clark St., Chicago 2, Ill.*

"Research," 72-page brochure R-14, goes into detail on organizational set-up and facilities for basic, applied, and developmental research. Included is a description of types of work carried on by various sections with examples of work on some of the unclassified projects. *Cook Electric Co., Dept. CE, 2700 Southport Ave., Chicago 14, Ill.*

"85% Magnesia Insulation Manual," 80-page booklet, a revision of the 1949 edition, offers new engineering and product data on heat insulation. Complete data are given applicable to hot piping and equipment for industrial, commercial, and institutional use. *The Magnesia Insulation Manufacturers Association, Dept. CE, 1317 F St., N.W., Washington 4, D.C.*

Industrial Instrument Catalog 5002, 26 pages, has been revised to include brief descriptions of principal types of Honeywell industrial instruments and equipment along with latest developments in the field. Each description includes a reference to more detailed litera-

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BOOKLETS

—Starts on page 74

ture. *Minneapolis-Honeywell Regulator Co., Industrial Div., Dept. CE, Wayne and Windrim Avenues, Philadelphia 44, Pa.*

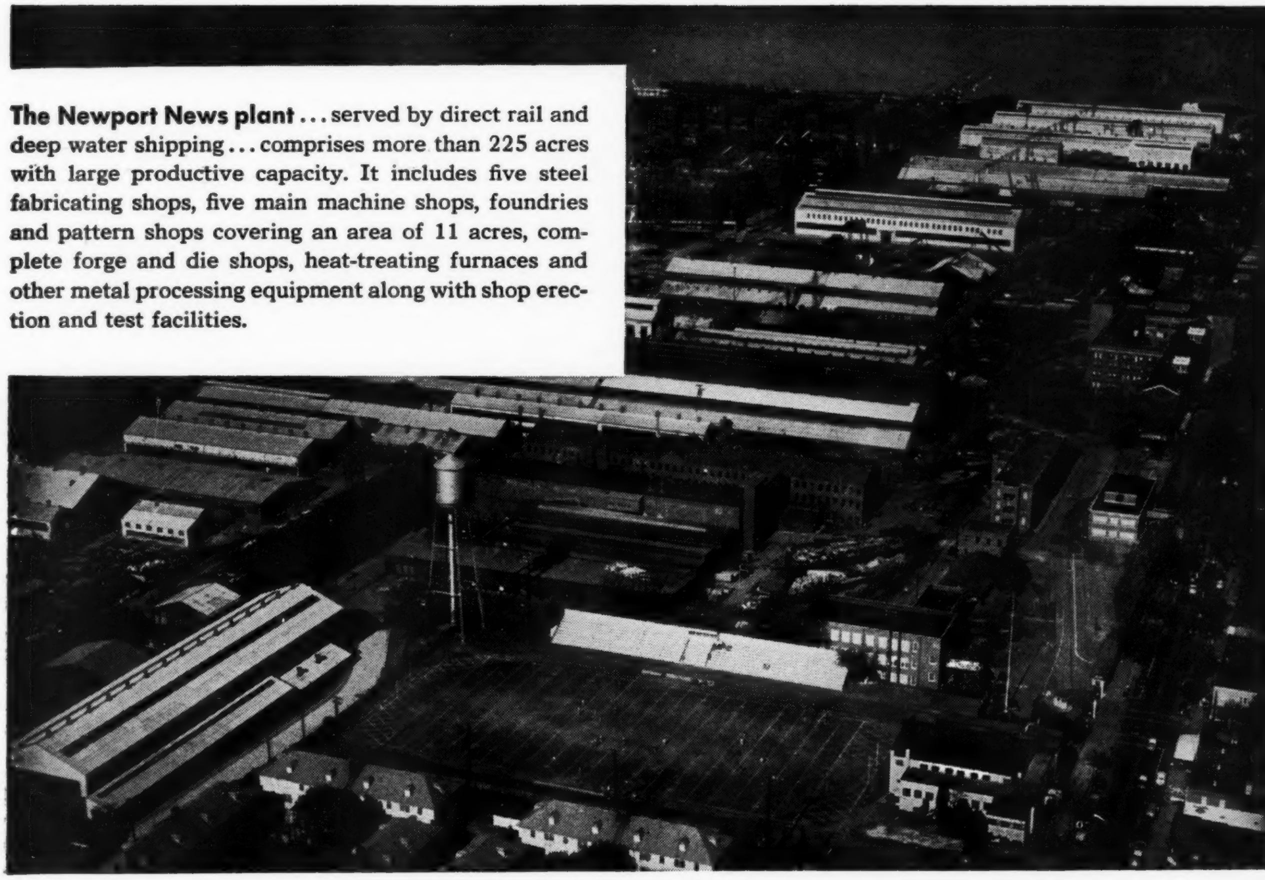
SUPERCHARGED GENERATOR — Test performance data on the first fully supercharged generator are contained in eight-page bulletin 05R8234. It summarizes and compares observed temperatures, losses, efficiencies, and characteristics of the supercharged generator with those of conventionally cooled machines. *Allis-Chalmers Mfg. Co., Dept. CE, 948 S. 70th St., Milwaukee, Wisconsin.*

ARCHITECTURAL METAL ITEMS for stairways and walkways including stair treads and thresholds in abrasive-surfaced cast metal of iron, aluminum, and bronze are presented in 12-page catalog 54. An elevation drawing is given for each item. *Wooster Products Inc., Dept. CE Wooster, Ohio.*

THIS ROOF INSULATING GUIDE, pocket size, gives the resistance (R) and U values of common roof construction — both uninsulated and insulated with various thicknesses of Foamglas cellular glass insulation. *Pittsburgh Corning Corp., One Gateway Center, Dept. CE, Pittsburgh 22, Pa.*

"ROTH TWO-STAGE POWER PLANT PUMPS," 12-page booklet 107, includes installation dimensions and performance tables, data on mechanical seals, and cross-sectional diagrams illustrating principle of operation of two-stage regenerative turbine pumps. *Roy E. Roth Co., Dept. CE, Rock Island, Ill.*

ELASTO-RIB, a rubber and cork damping material for the control of transmitted vibration and noise without bolting the machine to the floor, is described in 4-page bulletin K5A. Various types of fabricated Elasto-Rib Dampers are discussed. Loading charts, installation and arrangement drawings, and specifications are given. *The Korfund Co., Inc., Dept. CE, Long Island City, New York.* ▲▲



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REPORT FROM FRANKFURT

FRITZ D. HIRSCHFELD
European Editor

CE exclusive

THE WORK OF the Battelle Memorial Institute, Columbus, Ohio, in technical and scientific research in the United States, is well known. Founded in 1929 (through the will of the late industrialist, Gordon Battelle) as a non-profit organization for the purpose of "developing new products or materials—exploring new processes—solving technological problems", it has grown from a nucleus of a small pioneer staff with a few initial research contracts to a multi-million dollar business. Battelle is a consulting firm in the sense that it sells its independent technical services to a client for a fee although the emphasis of these services is in the field of industrial research.

While Battelle's work in the U.S. is generally familiar, its recent operations in Europe are less well-known to the consulting engineer.

It was in 1948 that Battelle took the first exploratory steps in probing the possibilities of extending its operations to Europe. The idea met with skepticism from all sides . . . European industry would never take an American technical research organization into its confidence . . . besides, Europeans did not have the money to spend on this sort of "luxury" . . . and why, it was asked, would a basically conservative Midwest firm, with plenty of actual and potential paying clients right here in the U.S., want to stick its neck out and risk money and reputation in the foreign field—especially in a highly technically and industrially developed area?

The comments from Europe were even less encouraging. Battelle representatives were told that the entire scheme was unsound. European industry had its own research facilities. The intrusion of Americans would be suspected and resented. Industry would never support this venture.

But Battelle persisted. On the basis of their investigations, they firmly believed that there was a need for large scale industrial research in Europe, and they went ahead with their plans to invest money in laboratories, equipment, and personnel to prove it. In spite of the skeptics, Battelle found qualified Europeans who had equal faith in the project and who were just as willing to invest their time and energy in the effort. With these resources and a grant of land from the Mayor of Frankfurt, Battelle found itself in business.

Today, with two laboratories—the smaller one in Geneva, Switzerland, staffed by about 75 technical people; the larger one in Frankfurt, with over 250 staff members—Battelle has successfully won the confidence of European industry in their integrity and ability to produce results and has obtained consulting research contracts from many enterprises throughout Western Europe (including a substantial number of former skeptics) in a wide range of scientific and technical development projects. According to Dr. Max Barnick, a scientist with a real down-to-earth charm and sense of humor, who was one of Battelle's earliest European supporters and who is presently in charge of the Frankfurt operations, the prospects are even more encouraging. In two to three years, if these expectations are realized, the entire Battelle operations in Europe will be completely self-supporting—an amazing record considering that they started less than five years ago.

It may be worthwhile to take a closer look at Battelle's pioneer European operations from the viewpoint of a precedent or yardstick by which to gage the possibilities of future American consulting activities in Europe.

From the Battelle experiences, these basic observations seem relevant:

¶ There are legitimate needs for American technical know-how in Europe;

¶ Europeans, just as Americans, will pay for any knowledge that will benefit their operations, and thus, of course, contribute to their profit;

¶ The profit motive and the desire for technical and industrial progress are common to all Europeans;

¶ To be acceptable, under most circumstances, American operations in Europe should be run by, with, and for the European.

To sum it up (realizing full well that the Battelle experiment represents a special case) Battelle has proven that an American technical consulting firm can successfully establish itself on the Continent.

If Battelle's technical research programs have been successfully sold in Europe, it's a sure sign that European industry will soon be in the market for the practical knowledge and experience to put these ideas into effect. American consultants have that experience and knowledge. It may be to their interest to review some of the thinking behind Battelle's activities and their success in the European experiment. Perhaps some of them will be tempted to guide their footsteps across the ocean! ▲▲

(For another aspect of foreign operations, see this month's Cover Story)


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More Coal From Austrian Mines

—Starts on page 34

of commercial establishments, the coal industry sent representatives from each of its mines, and these men learned enough about marketing techniques to help them in developing new markets. They were shown how to work out advertising programs, arrange credit systems, adjust prices for off season buying, provide customer service, and search for new markets. An interesting new market was developed in South Germany based on the short transportation run compared to the German mines from which they were buying.

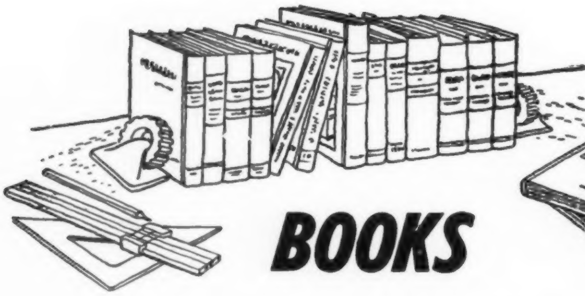
Shipping coal to Germany was a new idea, but another new idea was worked out for shipping it in the form of electric power. Austria has large hydroelectric stations that require steam standby plants used only in the winter. With plenty of coal available, the steam plants were put into summer operation, and the excess power was sold to neighboring Germany and Italy.

Mine Safety

With the production program well under way, MacDonald and Chick returned to the United States after a year of solid and fruitful work. The program then entered a new phase by the addition of Randolph Montieth, Safety Director of Coal Mines, for the Wierton Steel Corporation. Improvement of productivity is limited in these Austrian mines by a group of workers who are partially disabled as a result of mine accidents but who cannot be discharged by the mines. Obviously, the mines have a real obligation to these people, but they are a terrific financial burden to the operation. Unless safety measures are put in and enforced, the cruel accidents resulting from hazardous practices will continue to cripple the workers and generate more of these miners with partial disability. Appeals on the basis of humanity have been less successful than a demonstration that safety is good business. This idea was sold to the managements, and the program was started. Certainly, there was plenty of room for improvement. Miners generally had been wearing soft berets. They carried open flame carbide lanterns, never wore gloves, and hard toed shoes were completely unknown. Although highly skilled in timbering, the maintenance of their supports was atrocious. These conditions were corrected.

A Program Completed

Today, our part in the coal program in Austria is being closed out. It was one of the most successful of our foreign aid ventures. This success was due to our working on the real causes of the trouble, getting the Austrians to work out their own solutions, and urging them on with *competition, concentration,* and *mechanization.* ▲▲



BOOKS

TO ORDER BOOKS

As a readers' service, CONSULTING ENGINEER will order reviewed books or any other technical volumes you need. In ordering books, give title, author, and publisher and enclose check. We will also suggest titles of books on any technical subject and order for you at regular publishers' prices.

ELECTROPLATING ENGINEERING HANDBOOK, edited by A. Kenneth Graham; Reinhold Publishing Corp.; 650 pp.; $10.00.

Reviewed by Morris J. Berger
Research Metallurgist,
Armour Research Foundation

This book will probably find a conveniently reached place in the bookshelves of the engineer concerned with the field of metal finishing. It offers material of interest to both the practicing electroplater and the consultant, ranging from product design for effective plating, through finishing processes, and to cost estimation and control.

The material in the book is divided into two parts: General Processing Data, and Engineering Fundamentals and Practice. This reviewer found the first part particularly interesting, especially the chapters on Metal Surface Preparation and Cleaning, Plating Bath Compositions and Operating Conditions, Analysis of Plating Baths, Testing Electrodeposited Coatings, and Surface Protection and Finishing Treatments. These chapters are filled with information of practical value, presented in a concise and readable form.

The second part of the book is valuable for its chapters on Floors, Tanks, Linings, and Racks and especially the chapters on Barrels, and Exhaust Systems. These chapters supply the reader with much practical information for the design and construction of electroplating plants.

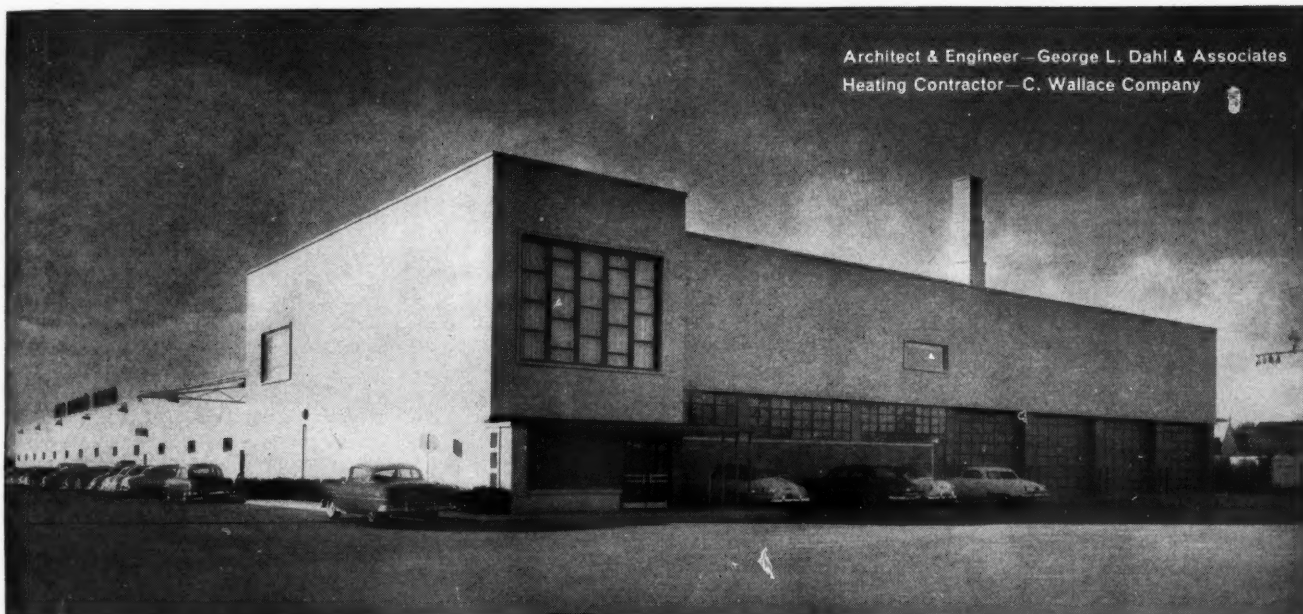
However, this reviewer would have liked to have seen more data concerning costs of equipment. Such information would have rounded out the otherwise excellent treatments of the various phases of plant design and operation.

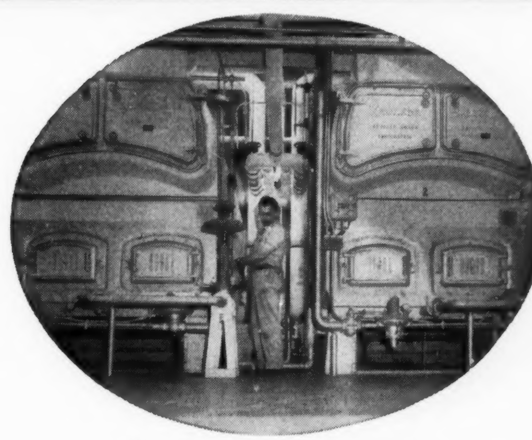
•

BASIC STRUCTURAL DESIGN, by David Singer; Pelex Publications, Inc.; Plastic Bound; $4.50.

Reviewed by Abraham Slavin
Consulting Engineer and Architect

This book is intended as the basis for a review course and as refresher material for the structural design part of the professional engineer


Architect & Engineer—George L. Dahl & Associates
Heating Contractor—C. Wallace Company



license examinations.

A general and detailed index would greatly facilitate its ready use. Data on influence lines for determining stresses in simple bridge structures would add to its value. More basic theory and additional data on shear for wood and steel structures, in particular for beams composed of built-up or combined sections, would be pertinent and valuable addition.

It appears that an attempt has been made to include some brief statements on theory to augment the problems which parallel those given in prior examinations. A decided improvement would be some enlargement of the basic theory in order to clarify the developed solutions and for the book to fully earn the inclusion of the word "Basic" in its title. The book as now presented is essentially a compilation of solutions to selected problems. There are a number of similar books that have been widely publicized which contain solutions to prior examination problems without claim to their content being basic. Some of our founder societies and a number of our engineering colleges issue solutions to prior examination problems. The accuracy of the solutions is not guaranteed, nor can a candidate for the engineering license completely understand or have a ready and working knowledge of the topics by merely studying these review and refresher books. It is essential that more basic theory be thoroughly understood and that the solutions to these problems become more than a substitution of numerical values into known and published formulas.

The effectiveness of presentation, except as previously noted, is good. In general, the topics are presented in an orderly fashion. The illustrations are excellent and of decided value to the reader.

The book is a contribution in the field of solving some, but not all, of the typical problems presented in the subject examination. It is recommended as a reference, but in conjunction with established texts as used in our engineering colleges, in preparation for the subject examination. It is also recommended as of value to a consulting engineer's library as a reference to solutions of some of the typical elementary structural problems.

•

CHEMICAL ENGINEERING IN PRACTICE, edited by James I. Harper; Reinhold Publishing Corp.; 140 pp; $3.00.
Reviewed by Walter L. Hardy

Director of Engineering
Foster D. Snell, Inc.

This book is a compilation of eight lectures presented as a symposium on "Chemical Engineering in The Process Industries." The symposium was sponsored jointly by the American Institute of Chemical Engineers

and the Dept. of Chemical Engineering, University of Pennsylvania.

This highly readable volume describes the role of the chemical engineer in Process Research, Process Development, Process Engineering, Economic Analysis, Project Engineering, Construction (Chemical Process) Engineering, Operational and Market Research Engineering.

The authors of the eight sections are eminently qualified by experience and position to discuss the activities of the chemical engineer in the development, design, procurement, installation, and operation of a chemical process. Unfortunately, in the opinion of this reviewer, the panel of experts did not choose a single product and carry it through from a proven marketable idea to a complete operating plant. Several chapters are based on reference to a particular process closely related to the current interest of the individual author. Greater continuity would have been obtained, better illustrating the cooperation between, and the interrelation of, the various chemical engineering "teams," had a single product been chosen for illustration.

Chemical Engineering In Practice is particularly recommended by this reviewer for the student, his parents, vocational guidance personnel, and others in a position to influence and guide young people to the chemical engineering profession.

ALSO AVAILABLE

THE AMERICAN STANDARD NATIONAL PLUMBING CODE; The American Society of Mechanical Engineers; 186 pp; $3.50.

Worked out under the co-sponsorship of ASME and the American Public Health Association, this code is intended for use by architects and contractors in the design and installation of plumbing equipment, by plumbing equipment manufacturers in design of their products, and by states and cities as a basis for regulation and ordinances. The code is not "mandatory" but is intended as a starting point in setting local standards which will be uniform with good practice used elsewhere.

•

A PROFESSIONAL LOOK AT THE ENGINEER IN INDUSTRY, National Society of Professional Engineers; 128 pp; $3.00 ($1.50 to NSPE members).

This book reviews the major causes of dissatisfaction among engineers in industry and the background and current status of drives to meet the engineers' problems by the development of engineers' unions. It goes on to suggest a series of remedial actions by management and individual engineers in the fields of professional status, employment conditions, and economic status. ▲▲

consulting engineer

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